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COLON STUDIES

VI. CECAL STASIS: ITS CLINICAL SIGNIFICANCE AND RELATION TO PROXIMAL COLON STASIS*†

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THE development of our present knowledge of proximal colon stasis‡ may be briefly summarized as follows:

The "modern era" opens in Germany in 1908 when Wilms published his historic paper on cecum mobile as the cause of many cases of so-called chronic appendicitis, and recommended cecopexy for the relief of this condition. The following year (1909) Klose also began writing on the mobile cecum and reported some of the earliest roentgen studies of cecal stasis. Two years later he described the operation of right colopexy which is perhaps the type of surgical procedure most commonly employed in this country at the present time. That same year (1911) there appeared the first important roentgen study in this field, namely, that by Stierlin on obstipation of the "ascendens" type.

At about this time (1910) Roux published the first of his papers, later collaborating with Duval and laying a firm foundation for the French school by his clear differentiation between right-sided and left-sided colonic stasis.

In the meanwhile (1904–1918), in England, Lane's gospel that intestinal stasis caused the formation of bands representing the "crystallization of lines of force" had resulted in an initial overemphasis of the radical surgical treatment of all forms of constipation. Much of the support for Lane's theories was furnished by Jordan's roentgen studies, although it was not till 1924 that these appeared in book form. In 1912 the British physiologist Keith first pointed out the persistence in man of the ceco-colic sphincteric tract, but it remained for Hirsch, of New York (1924), to work out the clinical significance of this condition. In 1915 Walton wrote a stimulating paper on the clinical aspects of visceroptosis in which he advocated the cutting of bands and the freeing of adhesions involving the right colon.

By 1912, interest in this subject had already become manifest in this country, for it was in that year that Coffey published his original ideas on the principles underlying the surgical treatment of gastrointestinal stasis. Just about this time, Case began his indefatigable researches on colon function which led him first (1914) to

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† This is the sixth of a series of articles: I. The redundant colon, Am. J. Roentgenol. & Rad. Therapy, 1924, *12*, 414; II. The low cecum. *Ibid.*, 1925, *14*, 207; III. The clinical significance of ileal stasis; its association with colitis. *Ibid.*, 1926, *16*, 1; IV. The roentgen diagnosis of colitis (the irritable colon). *Ibid.*, 1927, *17*, 405–416; V. The high cecum. *Ibid.*, 1928, *19*, 101–111.

‡ Throughout this paper the term "proximal colon stasis" will be used to indicate the general idea of retention in the right third of the large intestine. When particular reference is necessary to the exact location involved, the terms "cecal stasis" and "cecocolic stasis"—the latter indicating retention from caput coli to hepatic flexure—will be employed.

believe that the fixed rather than the movable cecum was more likely to cause stasis, and brought him later (1922) to the important conclusion that proximal colon stasis was due principally to exaggerated antiperistalsis which was caused in turn by factors originating in the distal colon. During this period Quain had also become interested in the relation between right coloptosis and duodenal obstruction, and by 1924 was able to publish his results in 52 patients, operated on by various procedures, with follow-up periods varying from one and one-half to five and one-half years.

Apart from the studies already mentioned, noteworthy roentgen contributions were those of Bensaude (1919) in France, and of Hurst (1919) in England, on the roentgenology of constipation in general, and of Bassler (1922), and of Cunningham (1923) in this country, on stasis in the cecum and ascending colon.

From the beginning of the period under discussion, practically all the European

FIG. 1. Cecal non-stasis. Appearance 24 hours after opaque meal; two stools. Ceco-colon empty.

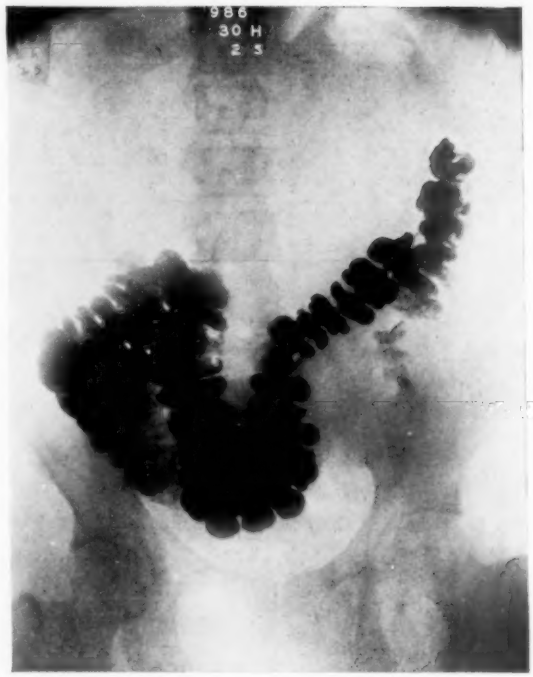

FIG. 2. Cecal non-stasis, despite angulation of proximal transverse colon. Appearance 24 hours after opaque meal; two stools. Ceco-colon still filled. Same case as Figure 3.

writers have insisted, with justice, on resurrecting the old clinical concepts of typhlatony, typhlitis, and perityphlitis, associating these conditions with proximal colon stasis. In this connection the early work of Wilms, Klose, Stierlin and Hurst, as well as Harvier's description of the localized colitides[5] will be found of interest. In the same work appears a helpful exposition of the coprologic findings in these conditions.

The past decade has witnessed some particularly important surgical contributions. In France, Duval and Roux brought out a well-rounded study of ceco-colic stasis in 1920; de Martel and Antoine published their book on "false appendicitis" in 1922; Desmarest and Mercier reported 20 cases of right colectomy in 1924; and in 1927, Duroux advocated division of adhesions and cecoplication for stasis due to right pericolitis. During the same interval two

Fig. 3. Cecal non-stasis, despite angulation of proximal transverse colon. Appearance 48 hours after opaque meal; three stools. Ceco-colon empty. Same case as Figure 2.

outstanding surgical contributions appeared in England. The first was Waugh's monograph (1920) on the "morbid consequences of a mobile ascending colon," the other Carslaw's splendid review (1928) on "right-sided visceroptosis." Gray's work in Canada (1924) must also be mentioned in this connection.

Despite the early studies by Coffey and Case and the more recent contributions of Hirsch and Quain already noted, it cannot be said that American interest in this field has kept pace with all the latest developments. To be sure, our own study of the low cecum in 1924 brought out some significant clinical relationships, but the rôle of cecal stasis was not carefully worked out, nor was any attempt made to elucidate the mechanism of the symptoms reported. The failure of appendectomy in relieving so-called chronic appendicitis has created a more conservative attitude, so that recent reports of surgical treatment of these conditions have been practically lacking. Fortunately, Houston's well-tempered paper on right-sided malposition of the colon, which has just appeared, reporting his personal experience with both medical and surgical treatment, will undoubtedly serve to reopen healthy interest, and stimulate further inquiry into the possibilities of surgical relief in this field of medicine.

Objectives, Methods, Criteria.

The present study does not profess to cover all the aspects of the problem. We have been particularly interested in obtaining answers to such rather elementary questions as: What are the exact roentgen criteria of proximal colon stasis? What effects can with certainty be ascribed to this condition? By what mechanism are such effects brought about? To this end, we reviewed a total of 2327 histories of private patients complaining of various digestive

Fig. 4. Cecal stasis. Appearance 24 hours after opaque meal; no stools. Same case as Figures 5, 6 and 7.

Fig. 5. Cecal stasis. Appearance 48 hours after opaque meal; two stools. Same case as Figures 4, 6 and 7.

disorders. The material was similar to that previously utilized for this series of papers. Of the patients above mentioned, 1430 were examined roentgenologically, and of these, 959 were found available for the present investigation. In practically every one of these 959 cases, the opaque meal was followed at daily or more frequent intervals until the barium was entirely eliminated from the colon.

We began our task by reviewing in a general way the emptying of the colon, and found that in the normal individual this organ is entirely clear of barium forty-eight, or at the latest, seventy-two hours after the administration of a standard opaque meal. It was accordingly obvious that stasis in the proximal colon for forty-eight hours or longer was an abnormal condition. Indeed, in many cases, the proximal colon was free from barium at the twenty-four hour observation.

Furthermore, since under normal conditions, the cecum and ceco-colon seem to empty into the adjacent colon before the latter expels its contents, it follows that in general, any relative lagging in the evacuation of the proximal colon may be regarded as abnormal, regardless of the absolute time factors involved.

With these impressions in mind, we proceeded to a more detailed investigation of the emptying of the proximal colon and found that roughly, three conditions could be differentiated, namely, cecal and ceco-colic non-stasis, cecal stasis, and ceco-colic stasis. These three classes could be further subdivided into six mutually exclusive* possibilities. These may be defined and described as follows:

1. Cecal and ceco-colic non-stasis, in which the cecum shows no tendency to pocket at any time and in which the entire proximal colon is empty within forty-eight hours after the administration of the bar-

* There were of course borderline cases, troublesome to classify and all the usual gradations in each group, from slight to well-marked examples.

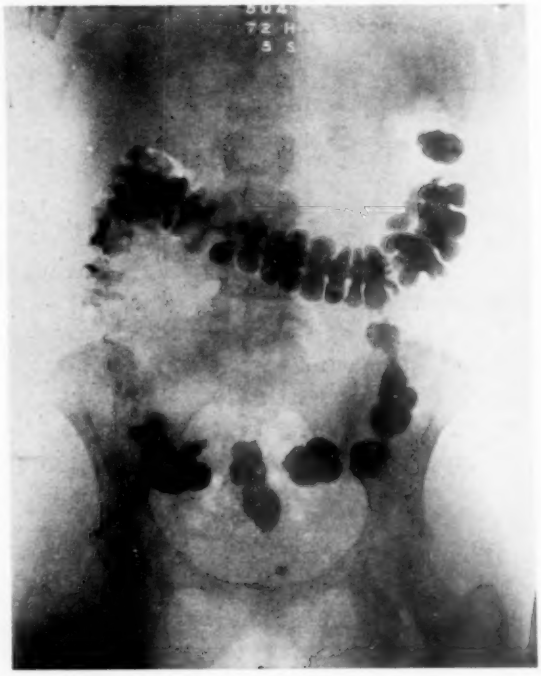

Fig. 6. Cecal stasis. Appearance 72 hours after opaque meal; five stools. Same case as Figures 4, 5 and 7.

ium meal. This is the "normal" condition (Figs. 1, 2 and 3).

2. Cecal stasis, in which a residue persists in the cecum proper for at least forty-eight hours after a barium meal, with the adjacent colon empty. This pocketing may remain as long as six days and even strong aperients may not dislodge it (Köhler, Schlesinger) (Figs. 5, 6, 7, 14, 15 and 20).

3. Twenty-four hour cecal stasis, in which a residue persists in the cecum proper for twenty-four hours only, with the adjacent colon empty (Fig. 8).

4. Secondary ceco-colic stasis, in which a residue persists in the ceco-colon for at least forty-eight hours with the adjacent transverse and distal colon filled (Fig. 17). When the ceco-colon finally empties in these cases, it empties without cecal pocketing. Otherwise these cases would properly be considered instances of cecal stasis.

5. Primary ceco-colic stasis, in which a residue persists in the ceco-colon for at least forty-eight hours with the adjacent transverse and distal colon empty (Fig. 18). This condition is analogous to cecal stasis but differs from it as does (4) above in that the ceco-colon empties without cecal pocketing.

Fig. 7. Cecal stasis. Appearance 96 hours after opaque meal; eight stools. Same case as Figures 4, 5 and 6.

Fig. 8. Twenty-four hour cecal stasis. Appearance 24 hours after opaque meal; two stools. The cecum was empty at the 48 hour observation.

6. Twenty-four hour primary ceco-colic stasis, in which a residue persists in the ceco-colon for twenty-four hours only, with the adjacent transverse and distal colon empty (Fig. 19). This condition is analogous to "twenty-four hour cecal stasis."

Each of these six groups of cases was subjected to the same statistical treatment in order to bring out differences in clinical significance. Exceptions to this procedure had to be made in respect to the last two groups on account of the fewness of the numbers, so that the figures for these are unavailable.

Special attention was paid to cecal stasis, not so much because of its actual importance as revealed in the course of this study, but rather because much had been

written about it, because it is a striking condition easily diagnosed roentgenologically, and because of the possibility that the more proximal the stasis, the more clear-cut should be any clinical picture that might result from such stasis.

ETIOLOGY

Many theories have been advanced to explain the phenomenon of stasis in the proximal colon. As a matter of fact, little, if any, experimental evidence has been adduced in support of these views. Perhaps a brief statement of some of the current hypotheses may prove of interest.

Cecal stasis was originally attributed to the presence of pericecal adhesions, either congenital in nature or resulting from appendicial inflammation. Although the influence of such adhesions, particularly when they cause manifest deformity, cannot be discounted (Figs. 13, 14, 15 and 16), it remained for Keith, and particularly for Hirsch, to point out the rôle played by the persistence in man of the ceco-colic sphincter found in some of the lower animals. According to this viewpoint which is now rapidly gaining ground, a spasm of the ceco-colic sphincteric tract, resulting from either local or distant causes may serve to close off the cecum proper with pocketing and stagnation in this region. Doubtless many observers have encountered roentgenograms strongly suggestive of the presence of such a sphincter, both after an opaque meal, and before and after the evacuation of a barium enema (Figs. 9, 10, 11 and 12). It must be pointed out, however, that not every case in which a ceco-colic sphincter is demonstrable, necessarily shows cecal stasis (Figs. 11 and 12).

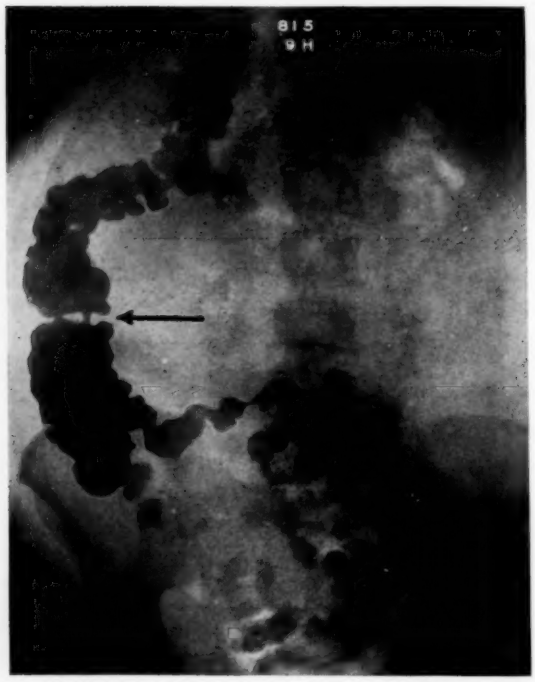

Fig. 9. Ceco-colic sphincter spasm (arrow). Appearance 9 hours after opaque meal.

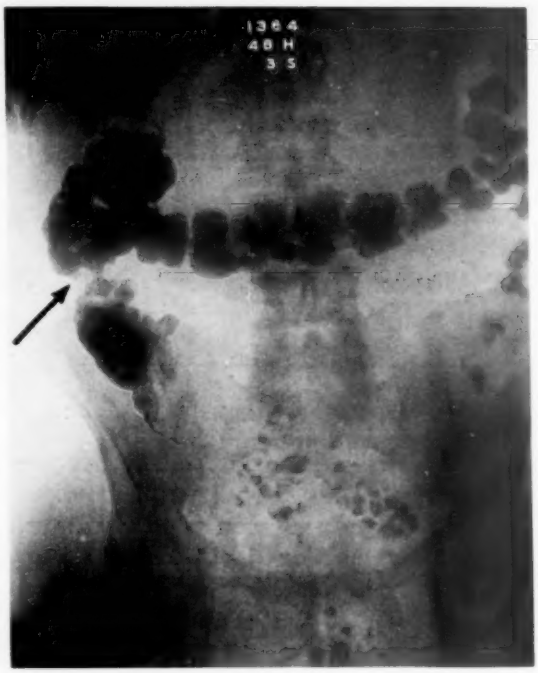

Fig. 10. Ceco-colic sphincter spasm (arrow). Appearance 48 hours after opaque meal; three stools.

Ceco-colic stasis has been ascribed to pericolic, and particularly to hepatocolic adhesions, to kinks or spasms of the hepatic flexure, to ptosis of the transverse colon, to intrinsic obstructive lesions, and finally to exaggerated antiperistalsis. The importance of the latter condition has been particularly emphasized by Case. He believes that the cause of exaggerated antiperistal-

Fig. 11. Ceco-colic sphincter spasm (arrow). Opaque enema. There was no cecal stasis after the barium meal. Same case as Figure 12.

tic activity is usually found in the distal colon, the most frequent etiologic factor being spastic constipation, although organic lesions may also play a rôle.

INCIDENCE

General. Cecal stasis proper occurred in 265, or about 27 per cent, of our 959 cases, whereas twenty-four hour cecal stasis occurred in 4 per cent. Secondary ceco-colic stasis was encountered 98 times, an incidence of 10 per cent. Primary ceco-colic stasis seems to be a rare condition as it occurred in less than 1 per cent of our cases. Schlesinger reports similar findings. Cecal non-stasis occurred in 57 per cent of our series. (For further details see Table 1.)

Sex. In cecal stasis, and particularly in ceco-colic stasis, the number of females exceeded that of males by about 5 to 4 and 3 to 2 respectively. These findings are in keeping with the greater incidence of low cecum in females (see the second article of this series).

Habitus. This did not seem to play much of a rôle, except possibly for a very slight preponderance of asthenics over sthenics in our cases of secondary ceco-colic stasis.

Table I
PROXIMAL COLON STASIS

Incidence of Various Forms	Cases	Per cent
Cecal non-stasis	547	57.1
Cecal stasis		
Cecal stasis proper (48 hours or more)	265	27.5
Twenty-four hour cecal stasis	38	3.9
Ceco-colic stasis		
Secondary ceco-colic	98	10.0
Primary ceco-colic	8	0.8
Primary 24 hour ceco-colic	3	0.4
Total	959	99.7

THE CLINICAL PICTURE OF PROXIMAL COLON STASIS

The symptoms associated with stasis in the proximal colon may be divided into

Fig. 12. Ceco-colic sphincter spasm. Appearance after evacuation of opaque enema (a common finding). Same case as Figure 11.

two groups, local and general. The most prominent local symptoms are pain and tenderness in the right lower quadrant. The pain is dull, dragging in character, and often constant in occurrence. Fever and rigidity are not present. A palpable, spastic or gurgling ceco-colon is a common objective finding. Ileal stasis occurs fairly often with cecal stasis. Whatever may be the nature of the original association between cecal stasis and appendicitis it is quite clear that appendectomy does not relieve the former condition, though it may improve the symptoms. Constipation is common of course in secondary ceco-colic stasis. Diarrhea is not frequently encountered except in the twenty-four hour cecal stasis group.

The only symptoms of a general nature that were subjected to analysis in the present study are headache and vomiting. Both of these are increased in proximal colon stasis. Other less tangible reflex or toxic effects have not been studied by us. In the literature one finds statements that such conditions as thyroid enlargement (Behan), idiopathic epilepsy (Armstrong), and dementia precox (Holmes and Retinger) are intimately associated with proximal colon stasis. In our series, the incidence of thyroid enlargement was not appreciably above the average, and as far as we know, there was only one case of epilepsy and none of dementia precox among these patients.

The cause of the symptoms in proximal

TABLE II

RELATION OF CECAL POSITION TO PROXIMAL COLON STASIS

	Position of Cecum					
	Low		Normal		High	
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
In 1226 unselected cases (general incidence)...	241	19.6	933	76.1	52	4.3
In 547 cases of cecal non-stasis.....	82	14.9	432	79.0	33	6.0
In 265 cases of cecal stasis.....	61	23.1	190	71.6	14	5.3
In 38 cases of 24 hour cecal stasis.....	5	13.1	30	79.0	3	7.9
In 98 cases of secondary ceco-colic stasis.....	33	34.0	63	63.9	2	2.1

Relation of Proximal Colon Stasis to Cecal Position

Incidence of	In 153 Low Ceca		In 217 Normal Ceca		In 35 High Ceca		General Incidence (for comparison)
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Per Cent
Cecal non-stasis.....	68	44.4	131	60.3	22	62.8	57.1
Cecal stasis.....	54	35.2	59	27.1	9	25.7	27.5
Twenty-four hour cecal stasis.....	4	2.6	11	5.1	2	5.7	3.9
Secondary ceco-colic stasis.....	27	17.6	16	7.3	2	5.7	10.0

colon stasis will be discussed in a subsequent section.

Relation of Proximal Colon Stasis to Cecal Position. The incidence of cecal stasis and particularly of secondary ceco-colic stasis was considerably greater in low than it was in normal or high ceca. Low ceca, conversely, occurred more often in cecal stasis (23 per cent) and in ceco-colic stasis (34 per cent) than in a large series of unselected cases in which the incidence was 19 per cent. Although the above figures seem to lend some support to the general impression that the lower the cecum, the greater the difficulty in emptying the proximal colon, nevertheless, it must be pointed out that the incidence of cecal non-stasis is still relatively high in low ceca,—to be exact, 44 per cent as against 60 and 61 per cent in normal and high ceca respectively. In other words, the emptying of the cecum is fairly effective despite its low position. It is well to keep these findings in mind, because as we hope to show later, it is the position of the cecum rather than stasis within the proximal colon that appears to be responsible for at least some of the symptoms in these cases.

Fig. 13. Cecal stasis due to angulation of ascending colon. Appearance 24 hours after opaque meal; four stools. Same case as Figures 14, 15 and 16.

Fig. 14. Cecal stasis due to angulation of ascending colon. Appearance 48 hours after opaque meal; four stools. Same case as Figures 13, 15 and 16.

Relation of Proximal Colon Stasis to Constipation. Stierlin has pointed out that proximal colon stasis is a cause of constipation, i.e., fecal retention in the distal colon. As far as our figures are concerned (see Table III) this cannot be denied, because there is the same relative increase in the incidence of ceco-colic stasis in constipation as there is of constipation in ceco-colic stasis. It is possible, however, that we may be dealing with a vicious circle in which the primary condition is the constipation, and that this produces a proximal colon stasis which, in turn, accentuates the constipation. On the other hand, a striking feature in many cases is the persistence of a residue in the cecum despite the regular passage of one or more bowel movements day after day,

for the better part of a week (Figs. 5, 6 and 7).

TABLE III

RELATION OF CONSTIPATION TO PROXIMAL COLON STASIS

Incidence of Constipation	Cases	Per Cent
In 947 unselected cases (general incidence)	522	55.1
In 547 cases of cecal non-stasis	282	51.5
In 264 cases of cecal stasis	150	56.8
In 38 cases of 24 hour cecal stasis	17	44.7
In 98 cases of secondary ceco-colic stasis	73	74.4

RELATION OF PROXIMAL COLON STASIS TO CONSTIPATION

Incidence of	In 455 Cases of Constipation		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	247	54.2	57.1
Cecal stasis	130	28.5	27.5
Twenty-four hour cecal stasis	16	3.5	3.9
Secondary ceco-colic stasis	62	13.6	10.0

Relation of Proximal Colon Stasis to Colitis. As might be expected, the more marked and extensive the stasis in the proximal colon, the less marked was the irritability of the colon as expressed in the syndrome of colitis, the roentgen characteristics of which were given in a previous paper. Thus, colitis was encountered least often in the secondary ceco-colic stasis group and most often in the twenty-four hour cecal stasis cases (see Table IV).

In this connection it may be interesting to note that certain authors (de Martel and Antoine, Harvier, Roux, Hurst) have pointed out that in cecal stasis a period of constipation may terminate in a "diarrheal debacle" characterized by eight or ten stools in twenty-four hours. In our series of cases, diarrhea in general showed the same incidence as colitis, namely, it was

FIG. 15. Cecal stasis due to angulation of ascending colon. Appearance 72 hours after opaque meal; five stools. Same case as Figures 13, 14 and 16.

TABLE IV

RELATION OF COLITIS TO PROXIMAL COLON STASIS

Incidence of colitis	Cases	Per Cent
In 934 unselected cases (general incidence)	371	39.7
In 536 cases of cecal non-stasis	233	41.6
In 263 cases of cecal stasis	102	38.7
In 37 cases of 24 hour cecal stasis	19	51.3
In 98 cases of secondary ceco-colic stasis	27	27.5

RELATION OF PROXIMAL COLON STASIS TO COLITIS

Incidence of	In 297 cases of colitis (with 9 hour observation)		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis in	169	61.6	57.1
Cecal stasis in	73	26.6	27.5
Twenty-four hour cecal stasis in	12	4.3	3.9
Secondary ceco-colic stasis in	20	7.3	10.0

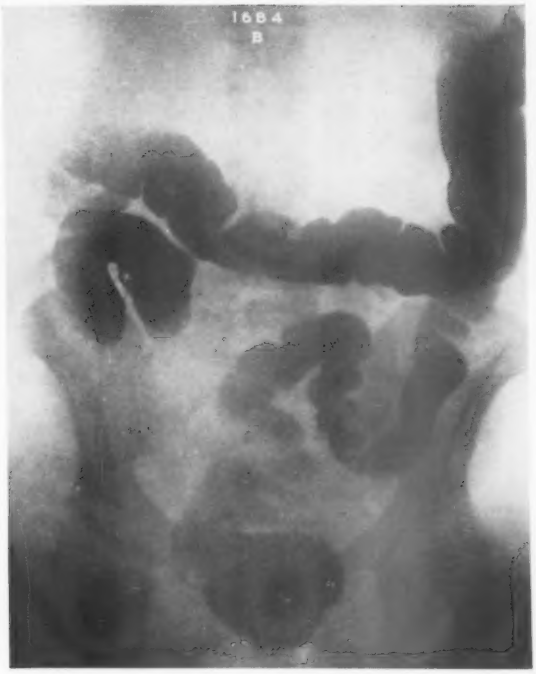

Fig. 16. Cecal stasis due to angulation of ascending colon. Appearance after opaque enema. Same case as Figures 13, 14 and 15.

Table V

RELATION OF ILEAL STASIS TO PROXIMAL COLON STASIS

Incidence of Ileal Stasis	Cases	Per Cent
In 500 unselected cases (general incidence)	257	51.4
In 296 cases of cecal non-stasis	148	50.0
In 132 cases of cecal stasis	81	*61.3*
In 26 cases of 24 hour cecal stasis	8	30.8
In 46 cases of secondary ceco-colic stasis	20	43.4

RELATION OF PROXIMAL COLON STASIS TO ILEAL STASIS

Incidence of	In 257 cases of ileal stasis		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	142	55.9	57.1
Cecal stasis	78	*30.7*	27.5
Twenty-four hour cecal stasis	8	3.1	3.9
Secondary ceco-colic stasis	26	10.2	10.0

not at all prominent in either cecal or ceco-colic stasis, but showed about a 33 per cent increase in incidence in twenty-four hour cecal stasis.

Relation of Proximal Colon Stasis to Ileal Stasis. Since ileal stasis occurs distinctly more often in cecal stasis than in ceco-colic stasis, it seems fair to assume an intimate relationship between cecal stasis and ileal stasis (see Table v). A possible explanation of this interesting association is that both conditions (cecal stasis and ileal stasis) are due to spasticity of the ceco-colic sphincteric tract.

In a previous paper, the rôle of ileo-cecal sphincteric spasm in the production of ileal stasis was emphasized. To this factor in the etiology of ileal stasis must now be added spasm of the ceco-colic sphincter, a concept which we owe to the painstaking investigations of Hirsch.

Relation of Proximal Colon Stasis to Right Lower Quadrant Pain and Tenderness. Right lower quadrant *pain* occurs one and one-half times as often in *cecal* stasis as it does in secondary ceco-colic stasis and vice versa (see Table vi). On the other hand, right lower quadrant *tenderness* occurs about one-fourth more often in secondary ceco-colic stasis than it does in cecal stasis (see Table vii). We have no explanation to offer for this interesting dissociation unless it be that pain (subjective) is more likely to be associated with spasm of the ceco-colic sphincter, and tenderness (objective) with a low position of the cecum.

Relation of Proximal Colon Stasis to Headache and Vomiting. Although headaches and vomiting occurred more often in both cecal and ceco-colic stasis than in the general series, these symptoms were particularly associated with retention in the ceco-colon rather than in the cecum alone (see Table viii). It will be recalled (see second study of this series) that both headache and vomiting are closely associated with a low cecum. As already

mentioned, and as we hope to show later, it is possibly the low position of the cecum rather than the retention within the ceco-colon that is responsible for the symptoms in the present series.

TABLE VI

RELATION OF RIGHT LOWER QUADRANT PAIN TO PROXIMAL COLON STASIS

Incidence of right lower quadrant pain	Cases	Per Cent
In 945 unselected cases (general incidence)	127	13.5
In 545 cases of cecal non-stasis	57	10.4
In 265 cases of cecal stasis	52	*19.6*
In 38 cases of 24 hour cecal stasis	5	13.1
In 97 cases of secondary ceco-colic stasis	13	13.4

TABLE VII

RELATION OF RIGHT LOWER QUADRANT TENDERNESS TO PROXIMAL COLON STASIS

Incidence of right lower quadrant tenderness	Cases	Per Cent
In 941 unselected cases (general incidence)	267	28.3
In 544 cases of cecal non-stasis	155	28.5
In 262 cases of cecal stasis	70	26.8
In 38 cases of 24 hour cecal stasis	10	26.3
In 97 cases of secondary ceco-colic stasis	32	*33.0*

RELATION OF PROXIMAL COLON STASIS TO RIGHT LOWER QUADRANT PAIN

Incidence of	In 127 cases of right lower quadrant pain		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	57	44.8	57.1
Cecal stasis	52	*40.9*	27.5
Twenty-four hour cecal stasis	5	3.9	3.9
Secondary ceco-colic stasis	13	10.2	10.0

RELATION OF PROXIMAL COLON STASIS TO RIGHT LOWER QUADRANT TENDERNESS

Incidence of	In 267 cases of right lower quadrant tenderness		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	151	56.5	57.1
Cecal stasis	74	27.7	27.5
Twenty-four hour cecal stasis	11	4.1	3.9
Secondary ceco-colic stasis	31	*11.6*	10.0

Relation of Proximal Colon Stasis to Appendix Stasis and to Appendectomy. A special investigation was made of appendix filling as demonstrated roentgenographically after a barium meal. As a preliminary, 396 cases were reviewed. Appendectomy had been previously performed in 93, or 23 per cent, of these. In the remaining cases, 58 per cent showed filling of the appendix with barium at some time after the opaque meal, each case being followed until the colon was clear. Forty-five per cent showed appendix stasis, as determined by retention of barium in this organ for forty-eight hours or more. Ten per cent showed advanced appendix stasis, i.e., retention for ninety-six hours or longer (Fig. 20).

As might be expected, the incidence of appendix stasis and advanced appendix stasis was high in both cecal and ceco-colic stasis, more particularly in the latter (see Table x) (Fig. 20). Conversely, the incidence of cecal stasis and especially ceco-colic stasis was relatively high in advanced appendix stasis (see Table xi). The incidence of appendectomy was slightly higher (28 per cent) in both cecal and ceco-colic stasis, than in the general series (23 per cent) (see Table x). On the other hand, the incidence of both cecal and ceco-colic stasis was slightly higher in appendectomized individuals than in those not operated on (see Table xii). The evidence therefore seems clear that appendectomy tends to increase rather than to relieve proximal colon stasis.

TABLE VIII

RELATION OF HEADACHES TO PROXIMAL COLON STASIS

Incidence of headache	Cases	Per Cent
In 947 unselected cases (general incidence)	255	26.9
In 547 cases of cecal non-stasis	140	25.5
In 265 cases of cecal stasis	74	*27.9*
In 38 cases of 24 hour cecal stasis	7	18.4
In 97 cases of secondary ceco-colic stasis	34	*35.1*

RELATION OF PROXIMAL COLON STASIS TO HEADACHES

Incidence of	In 258 cases of headache		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	141	54.6	57.1
Cecal stasis	75	*29.0*	27.5
Twenty-four hour cecal stasis	7	2.7	3.9
Secondary ceco-colic stasis	35	*13.5*	10.0

TABLE IX

RELATION OF VOMITING TO PROXIMAL COLON STASIS

Incidence of vomiting	Cases	Per Cent
In 948 unselected cases (general incidence)	210	22.1
In 547 cases of cecal non-stasis	108	19.7
In 265 cases of cecal stasis	64	*24.1*
In 38 cases of 24 hour cecal stasis	5	13.1
In 98 cases of secondary ceco-colic stasis	33	*33.7*

RELATION OF PROXIMAL COLON STASIS TO VOMITING

Incidence of	In 214 cases of vomiting		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	108	51.4	57.1
Cecal stasis	64	*30.4*	27.5
Twenty-four hour cecal stasis	5	2.3	3.9
Secondary ceco-colic stasis	33	*15.7*	10.0

FIG. 17. Secondary ceco-colic stasis. Appearance 48 hours after opaque meal; one stool.

FIG. 18. Primary ceco-colic stasis. Appearance 48 hours after opaque meal; three stools.

TABLE X

RELATION OF APPENDIX FILLING TO PROXIMAL COLON STASIS

	Incidence of Appendectomy		Number of Appendices Available for Filling	Incidence of Appendix Filling		Incidence of Appendix Stasis (48 hrs.)		Incidence of Advanced Appendix Stasis (96 hrs.)	
	Cases	Per Cent	Cases	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
In 396 unselected cases (general incidence)...	93	23.4	303	177	58.4	135	44.5	31	10.2
In 219 cases of cecal non-stasis.....	46	21.0	173	95	54.9	69	39.9	9	5.2
In 108 cases of cecal stasis.....	30	*27.8*	78	51	*65.4*	43	*55.5*	14	*17.9*
In 26 cases of 24 hr. cecal stasis.....	5	19.2	21	13	61.9	6	28.6	0	0
In 43 cases of secondary ceco-colic stasis.....	12	*27.9*	31	18	58.1	17	*54.8*	8	*25.8*

TABLE XI

RELATION OF PROXIMAL COLON STASIS TO APPENDIX FILLING

Incidence of	In 379 Cases of Appendix Filling		In 104 Cases of Appendix Stasis		In 30 Cases of Advanced Appendix Stasis		General Incidence (for comparison)
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Per Cent
Cecal non-stasis.....	203	53.5	59	56.6	10	33.3	57.1
Cecal stasis.....	108	28.4	29	27.9	14	*46.7*	27.5
Twenty-four hours cecal stasis.....	26	6.8	6	5.6	0	0	3.9
Secondary ceco-colic stasis.....	42	11.0	10	9.6	6	*20.0*	10.0

THE CAUSE OF SYMPTOMS IN PROXIMAL COLON STASIS

We are now in position to consider our third basic question: What is the mechanism of the symptoms in proximal colon stasis? Are they due entirely to absorption of toxins, as is generally assumed, or may some other factor be operative in their production?

Table XIII presents a synoptic review of certain general symptoms (headache, vomiting), and certain local symptoms and signs (right lower quadrant pain and tenderness). The uppermost line gives the general incidence of these conditions in a large series (over 1000) of unselected cases. In the lines below, the incidence of these factors is distributed for cecal stasis and for ceco-colic stasis, respectively,

TABLE XII

RELATION OF PROXIMAL COLON STASIS TO APPENDECTOMY

Incidence of	In 191 cases of Appendectomy		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	104	54.4	57.1
Cecal stasis.....	56	29.3	27.5
Twenty-four hour cecal stasis.....	7	3.6	3.9
Secondary ceco-colic stasis.....	24	*12.5*	10.0

TABLE XIII

RELATION OF CERTAIN GENERAL AND LOCAL SYMPTOMS TO PROXIMAL COLON STASIS AND CECAL POSITION

		Headaches	Vomiting	Right Lower Quadrant Pain	Right Lower Quadrant Tenderness
		(per cent)	(per cent)	(per cent)	(per cent)
In unselected cases (general incidence)		25	19	13	28
In cecal stasis	low ceca	*31*	*45*	*21*	*27*
	normal ceca	26	17	18	27
	high ceca	21	14	14	14
In secondary cecal stasis	low ceca	*48*	*48*	*18*	*51*
	normal ceca	26	26	9	22
	high ceca		Two cases only		

in regard to the position of the cecum, whether it be low, normal, or high,—except in the case of high cecum in ceco-colic stasis, in which group only two cases were available. As is readily seen, the incidence of these symptoms and signs is from one and one-half to over two times as high in the low ceca group, as in the normal or high ceca.

The conclusion therefore seems permissible that the symptoms of proximal colon stasis may not be due to the stasis as such, for this should be equally operative no matter in what location it occurs, but that it is the position of the cecum that is the responsible factor. In other words, the phenomenon may not be intrinsic, but may be extrinsic as far as the

FIG. 19. Primary 24 hour ceco-colic stasis. Appearance 24 hours after opaque meal; two stools.

FIG. 20. Cecal stasis with advanced appendix stasis. Appearance 120 hrs. after opaque meal; five stools.

colon is concerned. Although the final solution is not yet at hand, one is strongly tempted to ask whether the symptoms associated with low cecum (and incidentally with proximal colon stasis) may not be produced much higher in the alimentary tract, namely in the duodenum, as a result of transient blocking of this organ by the intermittent dragging of an elongated ceco-colon. For an illuminating and more detailed exposition of this general viewpoint, Carslaw's recent paper should be consulted.

To be sure, some of the ill effects of proximal colon stasis may be due to the absorption of locally produced toxins. Nevertheless, it is well known that so long as the liver remains competent, it forms a very effective barrier between poisons known to arise in the intestine and the general circulation. Furthermore as has recently been shown by Wangensteen and Loucks, when such a powerful toxin as histamine is injected into the lumen of the normal intestine, the absorption of this substance is practically negligible. That the situation is otherwise when the gut is unusually permeable or when the liver or other defensive mechanism is impaired, is of course quite conceivable.

In short, although it must be admitted that the colon may be the seat of important changes of a bacterial, chemical, or metabolic nature, further precise information in this direction is extremely desirable. In our work to date we have disregarded this aspect of the problem in the pursuit of other possibilities.

THERAPY

The object of treatment is obviously to improve proximal colon emptying. This may be brought about by:

1. Relieving the constipation.
2. Relieving the ceco-colic spasm and irritation.
3. Fattening cure.
4. Surgical treatment.

Relieving constipation is desirable because it clears the track ahead and prevents back-fire into the cecum. In at least 10 per cent of the cases—namely, those with secondary ceco-colic stasis—this may be all that is necessary to achieve a cure. In general, the gentlest measures are the safest. Irritating irrigations and violent purges should be avoided. Restoration of normal colon function is best achieved by such conservative procedures as rest, smooth diet, and adequate water drinking. If drugs appear indicated, lubrication with emollients from above and below should first be attempted. If this is inadequate, an infusion of senna pods, which is said by Stierlin to have a specific effect in emptying the ceco-colon, may be prescribed in gradually decreasing dosage. Castor oil at weekly intervals is sometimes well tolerated. In other cases, a series of gentle but thorough colonic irrigations may remove old residues and start spontaneous and more effective bowel action. Theoretically the best form of irrigation would be that in which the cecum is directly tapped and lavaged. Although many attempts have been made at cecal intubation, the difficulties are great and in many cases, insurmountable. A very fair presentation of the technical skill involved is that by Hoff.

Relief of ceco-colic spasm implies treatment of its cause. If there is local organic disease this must be removed if possible. Otherwise one must realize that much irritation may result from dietary factors. Proteins are said to cause intoxication from the intermediary or end products of their digestion (Roux). Cellulose-rich vegetables such as radishes, celery, and legumes are broken down by bacterial action in the ceco-colon with much gas production. Accordingly, the "soluble" proteins such as eggs, should be entirely omitted from the diet as well as raw vegetables (salads) and raw fruit, and in most cases, raw whole milk. Well-cooked meat may be allowed in small amounts. Spa-

ghetti, rice and potatoes are well tolerated.

In order to control "intestinal putrefaction" by changing the bacterial flora, the best results are obtained from the use in adequate amounts of acidophilus milk with the addition of lactose.

As in similar conditions elsewhere in the body, the general treatment for spasmophilia is here applicable, namely, rest, hot fomentations, general sedatives and the antispasmodics.

A fattening cure is very frequently useful when proximal colon stasis occurs in asthenics who are undernourished. The relief of symptoms from improving the nutrition is explained by the added support given the ptotic organs by increasing the mesenteric and properitoneal fat deposits. These in turn help overcome strain on important nerve pathways and promote the circulation.

If the above conservative measures fail in obtaining relief, surgical therapy may be considered. So far, we have had no experience with this form of treatment. Various procedures have been advocated, namely, division of pericolic membranes, cecoplication and ceco-colic fixation, short-circuiting by ceco-sigmoidostomy, and even resection of the right colon. At the present time the various forms of fixation of the ceco-colon seem to be the most popular procedures, Waugh having reported on 180 such operations, Quain on 52, Carslaw on 242, and Houston on 145. In view of the good results claimed for such conservative surgery, one would hesitate to recommend the more radical procedures (such as short-circuiting and resection). Finally, in the present state of our knowledge, it seems only proper to insist on a thorough trial of medical treatment, a careful selection of cases for surgical therapy, and their rigid control by appropriate pre- and post-operative study.

SUMMARY

1. Cecal stasis proper occurred in 27 per cent of 959 carefully studied gastro-intestinal cases. Its chief clinical associations are with low cecum (slight), right lower quadrant pain (fairly marked), ileal stasis (fairly marked), and appendix stasis (fairly marked). Appendectomy does not diminish the incidence of this condition.

2. Ceco-colic stasis occurs rarely (less than 1 per cent) as a primary condition. When associated with constipation (stasis in the colon distal to the hepatic flexure) its incidence is 10 per cent. In this form its chief clinical associations are with low cecum (fairly marked), right lower quadrant tenderness (slight), constipation (very marked), vomiting and headache (marked), and advanced appendix stasis (marked). Appendectomy does not diminish the incidence of this condition.

3. Cecal stasis is a condition of relatively minor importance. Ceco-colic stasis when associated with constipation is more likely than cecal stasis to give symptoms of clinical significance. Ceco-colic stasis in its primary form (i.e., not associated with constipation) is encountered so seldom that its clinical meaning cannot as yet be established by the statistical method employed in these studies.

4. Neither cecal stasis nor ceco-colic stasis seems capable in itself of causing disorders of marked clinical importance. Thus, when these forms of retention occur in the presence of normal or high ceca, symptoms are relatively uncommon. When they occur in the presence of a low placed cecum, symptoms are much more frequent. This evidence seems to favor the view that the symptomatology in many of these cases may be due to the effect of the colon dragging on adjacent organs (possibly the duodenum) rather than to absorption from within the proximal large intestine.

5. It seems reasonable to conclude from this investigation that the treatment of right colon stasis should be directed primarily toward the restoration of colon function by such procedures as the re-

lief of constipation, by antispasmodics, and by fattening the patient. If such conservative measures fail, it is possible that surgical intervention may prove useful. Appendectomy is definitely worthless as far as correcting cecal stasis is concerned. The release of constricting bands and some form of ceco-colic elevation or fixation are procedures that appear worthy of consideration. These suggestions, however, are as yet theoretical, as we have had no personal experience with surgical therapy. Careful selection of cases and control by pre- and postoperative study are most desirable in the present stage of our knowledge.

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DISCUSSION

Dr. J. T. Case, Battle Creek, Mich. I wish I might show Dr. Kantor's first slides again. Three or four of them I would like to comment upon. I would like the third one and then about the eighth or ninth which calls for twenty-four hour cecal stasis.

I am glad Dr. Kantor has seen fit to investigate this question of stasis in the colon. I am glad he did not fail to emphasize the fact that there is a physiological basis for the distribution of the colonic residues, but I cannot quite agree with him that it is normal for the colon to require forty-eight hours for emptying. Even if it were normal, it is hard to see what provision of an economical nature would make it necessary for the body to retain the residues more or less for forty-eight hours after the greater portion of the meal has been abstracted during the eight hours it consumes in passing through the stomach and small intestine.

We all have seen the mass movements which take place in the colon and we know that the distribution of colonic residues has an important bearing or dependence upon recent mass movement. For instance, in this slide which I have asked Dr. Kantor to show again, we see what looks like residues accumulating in the rectum and lower sigmoid and then naturally piling up along the sigmoid toward the splenic flexure, with here a vacant space which does not mean spasm but merely the normal appearance after a mass movement has passed by and left some residues in the colon.

Again in this next slide we see a typical appearance following mass movements. I have watched under the fluoroscope hours at a time in cases of this sort; and I have seen four or five mass movements appearing within a half hour previous to such a roentgenogram as this. For instance, the patient may have had an evacuation of a very small amount of material. Following that evacuation there has been a readjustment of the contents of the colon. This readjustment is shown in this slide and the principal mass of the sigmoid content has slipped on down into the rectum itself, leaving this characteristic appearance in the iliac colon; and then after a few minutes, another movement occurred and brought material from the bowel higher up down to this point, and it also seems that there was a mass movement which began over in the cecum. I have often wondered whether they should begin at the tip of the cecum or at the cecocolic sphincter. In my observations, they usually begin at about the ileocecal junction and push the material distalwards into the left half of the colon.

As you know, during these mass movements there are no haustral markings to be seen in the segment under motion. When the mass movement has come to an end, the haustral markings re-appear. Taking this next slide just as it is, there has been a recent mass movement from this part on; then within fifteen or twenty minutes after this film was made, the mass movement apparently emptied the cecum itself.

I just want to emphasize the fact that it is almost impossible to interpret many colonic films without knowledge of the hours at which the bowel movements had occurred in the particular case and something more or less as to the efficiency of those movements. We also, as Dr. Kantor very well brought out, need to know what surgery has been done, and in talking of any individual case where cecal stasis appears to be present, it is well to know whether or not the appendix has been removed. It is very interesting to me to know that he found twenty-three and a fraction per cent had had appendectomy. In counting over 2000 successive entries at the Battle

Creek Sanitarium, I found that just 25 per cent had had the appendix removed. That was fifteen years ago.

I was interested the other day in having one of our colleagues, Dr. Eggleston, report a series of cases of colitis in which he found that 26 per cent had had the appendix removed, so it seems to me the proportion of appendectomies in this country has reached a stabilized level and apparently the surgeons are removing about one-fourth of the appendices.

I would like to repeat that I think we should take into careful account this question of the physiology of the colon and it might be well to recall here the old classification given out many years ago by our friends in Germany and Austria relative to the types of constipation. We see relatively few cases nowadays of the so-called atonic constipation, that is, truly atonic constipation. Most people have either the hypertonic or the spastic type of constipation as we now call it, which shows a tendency to stasis in the proximal colon, and we see the mixed type where we have atonicity of the cecum, colon, and of the rectum itself and hypertonicity or spasticity of the intervening portions. As I say, the purely atonic constipations are very rare.

It all shows us that many of the appendectomies for so-called chronic appendicitis which have been done, have been done under a mistaken idea. The thing which causes the pain in the right side in these chronic cases is not the appendix itself but it is the stasis in the cecum. This distention can often be made to reproduce the pain by giving the patient a barium enema or by distending the colon.

DR. SHERWOOD MOORE, St. Louis, Mo. I should like to ask Dr. Kantor in what type of individual he finds cecal stasis, i.e., what is their general physical makeup, and also if he has definite views on the relationship of these redundancies and low positions of the cecum and other segments of the colon to the habitus of the patient.

DR. KANTOR, (closing). To answer the last question first, Dr. Moore, the habitus figures appear in a table in the paper but they were not considered sufficiently interesting to present on the screen. Cecal stasis, like low cecum, predominates slightly but very definitely in asthenic people, and particularly in asthenic women.

I don't believe the evidence would support the conclusion that the lowness of the cecum is a result instead of being a cause of the phenomena in question, and for this reason, although it is possible that in some cases the colon will elongate as a result of chronic constipation or distal colon obstruction, the evidence now I think is preponderant to the effect that this is all a congenital business. This is proved by studies made on fetuses and by Larrimore of St. Louis on infants within one day and again within one month after birth—he gave enemas to these subjects to study the shape of the colon and found that the incidence of what we claim are anomalies throughout this whole work is almost identical with that of any other age group.

Dr. Case has pressed a point about the normal standard of colon emptying. Naturally Dr. Case and I who agree 99 per cent of the way cannot be expected to agree 100 per cent. His institution supports the theory, is based on the theory, succeeds on the theory, let us say, that one should be a vegetarian and that one should have three bowel movements a day, and all we say to that is it works all right in Michigan, but it doesn't seem to work in New York, and our figures are based on the individuals that we see here. We believe that all of you here are more likely to have a residue at forty-eight hours after the meal than you are to get rid of it in twenty-four.

Vol. XXIV, No. 1

THE INTERPRETATION OF SINUS ROENTGENOGRAMS*

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THE roentgen ray as a diagnostic aid in disease of the nasal accessory sinuses has been in general use for at least fifteen years. During this period there has probably been less improvement in the method than in any other field of roentgen diagnosis. This seems strange as there are no basic fundamental obstacles to the method such as in roentgen diagnosis of gall-bladder disease, for instance.

The accuracy of abdominal diagnosis in this period has increased remarkably because we have expended time and effort in studying abdominal pathology and make our examinations with great care, using an elaborate technique and repeating our processes with endless detail. To obtain the same accuracy in diagnosis, a roentgen study of the accessory sinuses should be made as carefully and with as much attention to detail. This involves:

1. Negatives of the greatest possible technical excellence.
2. The use of standard angles of exposure which can be accurately reproduced.
3. Exposures at all possible angles, which includes at least three different angles in the posteroanterior projections.
4. A careful study of the negatives so produced.
5. A knowledge of the pathological changes incident to sinus disease.

Little time need be taken to discuss the first requisite, good films. These can be produced in any laboratory if sufficient pains are taken to do so. The use of fine focus tubes, small diaphragms, and in my hands the Potter-Bucky diaphragm, has helped to improve the quality of sinus roentgenograms.

The use of standard angles cannot be stressed too strongly. I do not believe these angles can be guessed at, but think they should be measured by whatever means the individual worker prefers.

I still use the apparatus previously described[1] which serves the double purpose of placing the vertical plane of the skull parallel with the film and also indicates accurate angles for the posteroanterior projections. These angles use a line from the external auditory meatus to the glabella as their base line. This line corresponds roughly with the floor of the frontal fossa of the skull. By selecting definite angles to this base line for standard posteroanterior projections, standard normals are set up and the films of one patient become comparable with others.

I have found stereoscopic posteroanterior views to be as great an aid in sinus interpretation as stereoscopic films are in chest diagnosis. However, in making these stereoscopic views, the tube must be shifted lengthwise of the patient's body and not crosswise.

If stereoscopic plates are not made, several posteroanterior views at different angles are still necessary as it often happens that pathology will be demonstrated at one of these angles and not at others. This occurs so often that too much emphasis cannot be laid upon the necessity for numerous exposures. The same statement applies to the superior-inferior view which I consider indispensable.

In addition to these views, I also make the Granger view for the sphenoids and the lateral view as routine. I occasionally use the Rhese view and believe it is valuable if one is familiar with the findings at this angle.

Having produced these films of excellent quality with accurate projections so that there is neither distortion nor obliteration by overlying shadows, time must be taken

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.

Fig. 1. Mucocele in right antrum.

to study them carefully for pathology. This cannot be done by glancing at the wet film.

The last requisite, a knowledge of sinus pathology as demonstrated by roentgen changes, is the real stumbling block in the progress of sinus diagnosis. The difficulties are increased because the roentgenologist and the rhinologist do not understand one another even when they attempt to cooperate.

The object of this paper is to attempt to find a common meeting ground for these two widely different viewpoints of sinus disease.

The recognition of sinus pathology depends upon variations in the normal transparency to roentgen rays of these air cavities. These areas of abnormal density may be partial or circumscribed; that is, they may occupy only a portion of one or more cavities; or they may be uniform, thus filling up or obliterating one or more of the sinus cavities.

The common lesions which produce circumscribed areas of density are as follows:

1. Benign tumors, such as osteoma or fibroma.
2. Polypi.
3. Mucocele or cyst.
4. Hyperplasia of lining mucous membrane.
5. Malignant new growth.

Osteomata are recognized by their marked density with sharply defined borders and continuity of structure with neighboring bony structures. They are probably without pathological significance as they are often seen in sinuses that seem to be otherwise normal. I have not been able to differentiate fibromata from polypi on the roentgenogram.

Polypi. Where these growths are not so numerous as to fill up the sinus and thus cause a general opacity, their contours can generally be made out as circumscribed shadows with smooth borders, round or pear-shaped, single or multiple. They are most easily recognized in the antrum or frontal sinus, with more difficulty in the ethmoids or sphenoids. They are difficult to differentiate from mucocele or cyst.

These latter conditions are apt to be larger and are always round. If polypi can be seen in the nose, it is reasonable to assume that circumscribed growths in the sinuses with the appearance described are of a similar nature. The appearance of cavities filled with polypi will be described under general opacities.

Mucocele or Cyst. These two cannot be

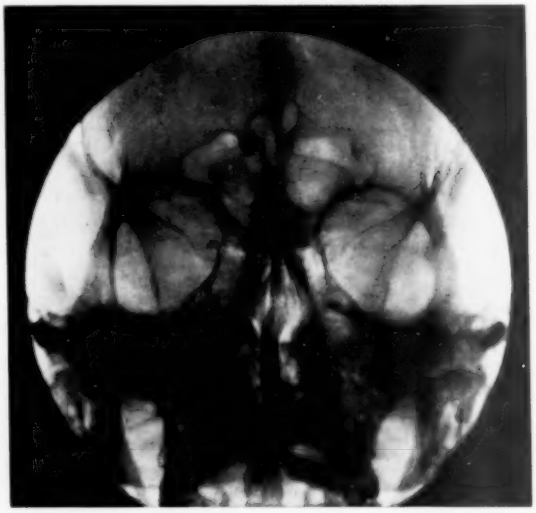

Fig. 2. Widening of both ethmoid regions characteristic of extensive polyposis.

differentiated from each other. The shadow is round and smooth, with well-defined borders, usually seen in the antrum, occasionally in the ethmoids. The condition is apt to be accompanied by a hyperplastic sinusitis. Occasionally, the contour of the growth can only be recognized in one of the several views; hence the necessity for a sufficient number of films.

In doubtful cases, injection of the sinus with lipiodol will usually demonstrate the lesion. However, while this procedure gives striking results, if the preliminary films are of the proper quality and show the detail they should, mucocele will be demonstrated in most cases before lipiodol is injected.

Hyperplasia of Lining Membrane. The normal mucous membrane lining the sinuses is only a fraction of a millimeter thick. This membrane becomes thickened and fibrous as the result of chronic inflammation. This may accompany what is known as chronic hyperplastic sinusitis, where there is swelling and inflammation of the membrane with a clear exudate, either viscid or watery, but without pus. Or it may result from repeated attacks of purulent sinusitis with intervals of quiescence.

In either case, the membrane becomes thickened, sometimes up to a quarter of an inch, increased in density, with a sharply defined inner margin. This appearance can only be recognized in the antrum, or possibly the frontals, although I cannot recall having seen it in the latter location. If the process is old, healed and inactive, the membrane is unusually dense, the edge sharply circumscribed and the cavity decreased in size and clear. This state of affairs can usually be recognized without much question.

Fig. 3. Hyperplastic sinusitis in both antra and left ethmoids.

Fig. 4. Marked thickening of membrane in both antra from previous sinusitis, now inactive.

If the condition accompanies an active sinusitis, the inner margins of the membrane are apt to be fuzzy in appearance and the cavity somewhat blurred and opaque, probably from the presence of exudate.

Sometimes the roentgen changes as above described cannot be definitely classified and the differentiation must be made on history and physical examination. This the rhinologist can do if he is supplied with the proper interpretation of the roentgen findings.

If the condition is one of the recurring attacks of sinusitis and the roentgen examination happens to be made in an interval, or if the condition is old and healed, the roentgen findings will be positive and probably physical examination will fail to reveal pathology. Both the roentgenologist and the rhinologist should be conversant with this fact.

The thickening of the membrane is permanent and looks much the same in the roentgenogram: (1) whether the sinusitis is active; (2) during the interval between

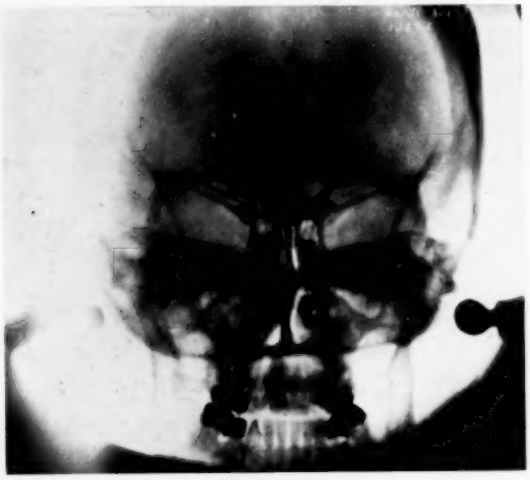

FIG. 5. Suppurative sinusitis in right ethmoids and right antrum with good drainage of the pus.

attacks in a recurring condition, even where this interval may be for long periods, or (3) in an old healed case where the attack may even be forgoten.

However, it is a fallacy to assume that this thickening of the membrane follows attacks of sinusitis in every case, as I have seen many cases both of chronic suppurative sinusitis and acute empyema of the antrum which have recovered without leaving any recognizable changes in the sinuses at all.

This does not apply to postoperative cases where the sinuses have been opened and the membrane curetted, or otherwise traumatized. These cases are always more or less opaque afterward, sometimes showing a definite edge of a thickened membrane and sometimes being generally blurred and opaque.

Malignant New Growth. The appearance depends on the nature and extent of the new growth. In sarcoma of the bones around the sinuses, the cavities are apt to be obliterated by the growth and the character of the lesion determined by the bony changes.

In carcinoma of the nasal cavity, mouth, or membrane lining the antrum, with extension into the sinuses, the sinus cavity is also usually obliterated by the growth and by pus which results from secondary infection of the lesion. Under these circumstances, the true condition of affairs is usually easily determined by physical examination. If not, the only roentgen change suggestive of carcinoma is erosion or destruction of bone in the neighborhood of the lesion.

General Opacities. The underlying causes of this change are always difficult to differentiate and often one can only suggest the various pathological processes which might produce the appearance noted and leave it to the rhinologist to complete the diagnosis from the history and physical findings.

Where the opacity is very dense and uniform, completely blotting out the sinus cavity, the differentiation is usually not difficult as this appearance is only caused by empyema, extensive polyposis, or new growth.

The consideration of new growth has already been discussed.

Between empyema and polypi, the only difference in appearance known to me is a marked widening of the ethmoid regions in extensive polyposis, apparently due to a pushing out of the bony walls by these numerous growths. As these cases of extensive polyposis usually involve all the sinuses, this change is present in the ethmoids and can be detected.

If, as occasionally happens, the polypi are limited to one or both maxillary sinuses, this sign is of no avail.

However, it is easy for the rhinologist to differentiate between pus and polypi, as in the one instance he can see pus draining into the nose or throat; and in the other, polypi in all probability will be present in the nose as well as in the accessory sinuses. If the rhinologist would keep this in mind and not blame the roentgenologist for failing to make a differentiation which is

sometimes humanly impossible, there would be no necessity for an error in diagnosis between these two conditions.

It should be remembered that a suppurative sinusitis does not always result in an empyema of the involved cavity. If the drainage is free, the pus will discharge almost as fast as it forms and the only recognizable pathology under these circumstances will be the changes in the mucous membrane incident to the inflammation. I do not believe that these changes produce a dense uniform opacity such as we see where pus accumulates in the cavity.

In my experience a sinus filled with pus casts a much more dense shadow than any inflammatory change in the mucous membrane. The characteristic appearance of the latter is not a uniform opacity, but the circumscribed shadow seen around the sinus walls where the rays travel through the membrane edgewise. The cavity inside these "edges" may be slightly opaque or blurred, due to increased resistance to the rays offered by the thickened membrane as it presents a flat surface to the radiation, but it does not show the complete obliteration of the cavity seen in empyema of a sinus.

A fluid level in empyema of the antrum is an uncommon finding. If the drainage is good in a chronic suppurative condition, the cavity keeps fairly empty. If drainage is blocked, it soon becomes entirely filled. In either instance, there would not be a fluid level. In the event that drainage is interfered with to just that degree to result in a small amount of residual pus, this accumulates in the inferior angle and may be overlooked. This residuum is apt to present a concave upper border and be mistaken for the natural wall of the cavity. It will only be demonstrated if exposures are made in the sitting posture and if the beam of the rays happens to be projected parallel with the surface of the fluid.

Slight Uniform Opacities. This group includes all those cases in which there is a slight and uniform decrease in the normal transparency of one or more cavities, often only recognized by careful comparison with the corresponding cavities on the other side. If both sides are affected, recognition

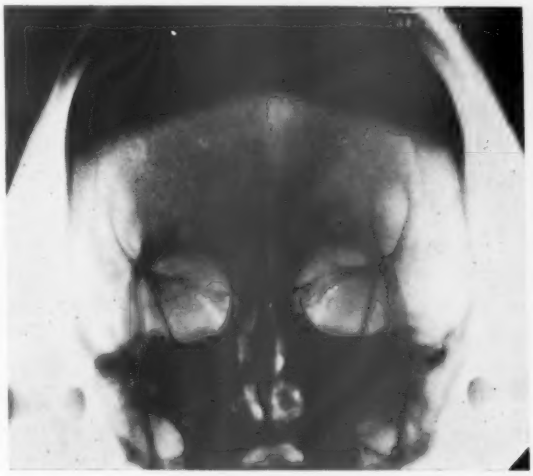

Fig. 6. Suppurative sinusitis in both ethmoids and both antra, with retention of pus.

is difficult and depends entirely upon the skill and experience of the one interpreting the negatives.

Improvements in technique have added somewhat to the difficulties since they have revealed changes not before recognized and the significance of these changes has not always been clearly understood.

In former times, the only pathology recognizable was so gross it could not be mistaken. The rhinologist has come to accept positive roentgen findings as meaning these gross changes. With the immensely superior films we are now able to produce, minor changes are demonstrated which have not at all the significance of the opaque sinuses of times past.

Slight uniform opacities of the sinuses are seen in the following conditions:

1. Congestion of mucous membrane as in acute colds or hay fever.
2. Slight thickening of the membrane left after recovery from a previous attack of sinusitis.
3. Following operations where the membrane has been traumatized.

4. Accompanying suppurative sinusitis where the pus is well drained out.
5. Chronic hyperplastic sinusitis.

It is obvious that the differentiation between these conditions cannot be made without information other than that obtainable from the roentgenogram.

If the patient has an acute cold one must, of course, be on his guard in interpreting slight opacities, especially of the antrum.

However, it must also be remembered that sinusitis not infrequently results from an acute cold, although when it does so, the drainage is usually impaired by the swollen mucous membrane, and an empyema of the antrum is most likely to occur. When drainage is reëstablished and the cavity empties, resolution usually follows, or occasionally the condition may gradually develop into a chronic sinusitis.

In hay fever, congestion of the membranes of the sinuses may be present as it is in the nose, but here again one must remember that a chronic sinusitis, either of the suppurative or hyperplastic type, is occasionally the cause of hay fever.

Postoperative cases in which the sinuses have been opened and the membrane subjected to traumatism usually show a permanent opacity of some degree. A knowledge of the history is essential for recognition of this condition.

The three remaining conditions which commonly cause slight opacities are: (1) thickened membrane after recovery from sinusitis; (2) suppurative sinusitis with free drainage; (3) chronic hyperplastic sinusitis.

The differentiation between these conditions is often impossible by roentgen examination. The antrum is probably the only cavity in which differentiation is ever possible.

Usually the healed case shows a thickened membrane with a sharply defined edge lining the walls of the antrum, with little decrease in the transparency of the cavity as a whole. Sometimes, however, the whole cavity is opaque.

In active suppurative sinusitis, a definite thickening of the membrane is not seen as commonly as in the other two conditions and if present, the edges are apt to be fuzzy and the whole cavity is usually slightly opaque.

In chronic hyperplastic sinusitis, the membrane is often quite thick, with fuzzy edges and a general opacity of the cavity.

The distinction between these three conditions is often quite impossible, but if the diagnosis can be narrowed down to them, the clinical differentiation is not difficult, as in the first instance the case is symptomless; the second shows pus draining into the nose or throat, and the third has symptoms of sinusitis either with a clear discharge, or without drainage.

In any roentgen report on the sinuses, all one can do is describe the findings, name the pathological conditions which give this appearance and state the one it most closely resembles. The final diagnosis can only be made with a knowledge of the history and physical examination.

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DISCUSSION

DR. SOLOMON FINEMAN, New York City. Dr. Grier is right in stating that the technique of sinus roentgenography is as difficult as anything we do in roentgenology. The most painstaking attention to details is required for the production of fine sinus roentgenograms. Without such roentgenograms, roentgen diagnosis is practically impossible.

Rhinologists, as a class, are dissatisfied with sinus roentgenography. One of the many pitfalls in sinus roentgenography is insufficient care in placing the patient's head on the film. The skull is but seldom symmetrical. The roentgenologist therefore must project upon the film an imaginary, perfectly symmetrical skull placed with the utmost care in the various required positions. The slightest rotation of the head upon its vertical or horizontal axis is sufficient to produce misleading shadows and opacities. Erroneous interpretation, which naturally follows the reading of technically poor and misleading roentgenograms, is responsible, I believe, for the criticism of many rhinologists.

On the other hand, some of the differences of opinion between the roentgenologist and the rhinologist are due to a failure on the part of many rhinologists to recognize the fact which Dr. Grier has pointed out, that in sinus disease one often finds the catarrhal type in which the washings are clear, but which none the less shows very marked changes in the sinuses.

Dr. Grier mentioned the recognition of polypi. As a rule, polypi can be detected readily on good roentgenograms. They are most frequently recognized in the antra. Occasionally they can be seen in the sphenoids or frontals.

The final point I wish to stress is that while sinus roentgenography is usually of very great aid to the rhinologist, instances occur in which for some reason or other the roentgen ray is unable to demonstrate pathologic changes when the clinical examination offers very positive evidence of such disease.

Dr. F. M. Law, New York City. I want to congratulate Dr. Grier on his very complete paper, so far as it went. It did not go far enough. He spoke of sinusitis as demonstrated by opacity. There is a different type of case that needs more help and that is the case in which there is no evident pathology as demonstrated to the roentgenologist. There are symptoms and there is reason to suspect a sinusitis but the roentgenologist sees apparently a fairly normal mucous membrane. This type of case occurs principally in cases of beginning blindness or in, as we have discovered lately, progressive deafness in children. In that particular type of case, the quality of roentgenogram that Dr. Grier spoke of is absolutely essential. I do not accept a film or plate unless the cancellous structure of the bone is clearly visible and in which every distinct partition of the ethmoid capsule is clearly outlined. I feel that we are missing a great deal in diagnosis if we do not consider the character of the bony partitions of the ethmoid capsule. There are two types, one in which the ethmoid cells are swollen, the wall is fuzzy, and semitransparent; the other in which they are clear-cut and clean as though they had been drawn with a fine point pen. Those have been removed, and under the microscope bear out the roentgen appearance, one showing edema and the other a condensing ostitis. In order to arrive at a diagnosis of that type of case, stereoscopic lateral exposures are necessary and thorough and complete study by someone who is expert in the use of the stereoscope. Not all roentgenologists see the stereoscopic images the same. This is particularly true of the ethmoids. With a properly made pair of stereoscopic plates of the ethmoids, you can distinguish the cellular structure on each side of the septum and if you will go over some of your films or plates with a knowledge of the history in view, and pick out the cellular structure, you will have a revelation in interpretation, and associate that with your clinical evidence, and you will give the rhinologist evidence that he has not thought possible.

Dr. R. R. Newell, San Francisco, Calif. I want to join in on Dr. Grier's plea for better sinus diagnosis and I want to thank Dr. Law for making me see the value of stereo-lateral examination of the ethmoids.

Better sinus diagnosis depends on two things —better pictures, i.e., better roentgenographic technique, and better seeing and interpretation by the roentgenologist. In regard to technique, I want to emphasize the importance of stereo examination, of complete immobilization, and of perfect centering of the patient. The anterior views should be taken in a true sagittal direction and the stereo shift should be made in a sagittal plane, so that both of the pictures of the stereo pair may be true sagittal projections. For me it is of value to have the patient sit up for the roentgenograms because in that way a sinus half full of fluid shows without equivocation, and one escapes the uncertainties of minor degrees of density.

I was glad Dr. Grier brought out the fact that maxillary sinuses which have been operated upon look very fuzzy and gray as a

rule. I think it is the duty of the roentgenologist to give a precise diagnosis and not be content with a report of "grayness in the right maxillary." I think he should report the maxillary as clear, lined with thickened mucous membrane, completely full of fluid, half full of fluid, or partly filled with a cyst or polyp, which, as Dr. Grier said, cannot be told apart by their roentgen appearance.

A fine division of diagnosis will be more helpful to a rhinologist than a mere report of suggested disease. I am able to see in many cases mucous membrane thickening in the ethmoid as well as in the frontals and in the maxillary and I have seen a few instances of definite mucous membrane thickening in the sphenoid sinuses.

Dr. Grier (closing). I am grateful for the kind remarks. I am sorry I did not start to read my paper from the back, because what I thought was the most important part of the paper is in the last two pages; and that is, the differentiation in the slight general opacities. These are the cases that get us in trouble with the rhinologist, because they may be due to a slight thickening of the membrane which has no significance at all, or to postoperative changes, or may mean hyperplastic sinusitis, or suppurative sinusitis which is draining well. There are four or five conditions with appearances all the same and one must have some idea of the history of the case in order to make a differentiation.

PSEUDOFRACTURES (HUNGER OSTEOPATHY, LATE RICKETS, OSTEOMALACIA)*

REPORT OF A CASE

By L. A. MILKMAN, M.D.
SCRANTON, PENNSYLVANIA

MISS G. M., aged forty, school teacher.

History of Present Illness. In June, 1925, due to lameness in the back, pain on stooping over, difficulty on arising from either the lying or sitting posture, also pain across the small of the back, the patient sought medical aid. First, she went to a chiropractor. After receiving a series of "adjustments" she felt no better. Therefore she decided to see her family physician, who referred her to a gynecologist, orthopedist, neurologist, and nose and throat specialist. Several internists also studied her, with apparently negative reports.

In 1926, the patient went to Clifton Springs, N. Y., where she was studied by Drs. O'Dell and Wilson. No definite diagnosis was made, and strapping of the sacroiliac region was recommended. In July, 1927, she was observed and studied at the University of Pennsylvania by Dr. Spiller and his associates.

At present, the patient states that her condition is getting worse. She used to walk to school daily. Now she cannot walk because as soon as she steps on her right leg, she feels a severe pain in the upper end of the right femur. There is also a feeling as if her leg were going to give way. Any attempt to go up or down stairs produces severe pain in the right leg, and less marked pain in the left. There is also a feeling of uncertainty, as if she might stumble in walking. She cannot sit down because of severe pain in the right leg, and difficulty in rising. She sleeps well, and has no pain at night. Her appetite is good.

Past Medical History. Native American, normal birth, breast fed. Pneumonia at two years of age. Measles and mumps during childhood. No whooping cough, no typhoid fever, no influenza, no tuberculosis, no osteomyelitis. Acne vulgaris between the ages of eighteen and thirty, for which she received many inoculations. She thinks the inoculations may have had something to do with her condition. She went on an orange juice diet for six weeks after onset of illness, and took exercise to reduce. She has had two attacks of appendicitis, but no operation. Three devitalized teeth were removed. Tonsillectomy in 1927. Two attacks of gravel in 1920 and 1922.

Family History. Father died at the age of sixty-five of arteriosclerosis. Mother is living and well at the age of seventy-four. No complaints at present. Patient is the seventh child of a family of eleven, nine of whom are living and well. One child died at the age of four of pneumonia. The other died ten days after birth—cause unknown. There is no family history of any peculiar bone lesions, bone operations, or malignancy.

Physical Examination. Adult female about 5 feet 3 inches tall, fairly well nourished, stands erect, no abnormal curvatures or bowing, does not appear to be suffering or in pain. She walks with a waddle gait, and if after sitting down is asked to rise, she hesitates for a while before rising, and then evidence of pain is noted in her expression. Questioned as to why she hesitates, she states that she has no strength in her muscles, also that time is necessary for her to get up the required energy to rise, and that the pain is also a factor. Her weight at present is 129 pounds, a loss of 10 pounds in four or five years.

Head. No deformities, does not appear pushed down at its junction with the neck. Nose and throat negative.

Eyes. Pupils round, equal and react to light and accommodation. Dark brown in color. *No blue sclerotics.*

Neck. Thyroid gland palpable, but otherwise no abnormal findings.

Chest. Pain on pressure over sternum and ribs. No crepitus felt.

Lungs and Heart. Grossly negative.

Abdomen. No palpable masses, no rigidity, no abnormal protrusions.

Gynecological Examination. Negative for new growth or other pathology.

Skeletal Examination. Bones of skeleton are apparently of normal growth, no bending or

* Read before the Philadelphia Roentgen Ray Society, Jan. 3, 1929.

bowing, or other deformities, no enlargement, no crepitus, no abnormal mobility. Tenderness over both femurs just below the trochanters, ribs and sternum as previously mentioned, also over right ulna. The patient is able to point out the tender spots. Knee jerks,++.

Neurologic examination by Dr. Spiller, report as follows:

I have found the study of Miss M's condition exceedingly interesting. There is much to suggest the presence of dystrophia myotonica in her case. Her age is in conformity with this diagnosis, and her lack of initiative in commencing voluntary movement with the lower limbs is very suggestive of this diagnosis. It is far from being a typical case. The disturbance of movement is confined to the lower limbs, and is one of failure at prompt onset of movement without any perseveration. Usually there is definite implication of the hands. The patient has perseveration, and when he grasps an object he is unable to let go of it immediately. Miss M. has none of this. Often there is myotonic electrical reaction. She shows none of this. Reactions of the muscles of the back and lower limbs are normal, there is no suggestion of the slightest degree of myotonic rereaction. Often there is muscular atrophy. No atrophy is present in her case. Frequently, striking the thenar eminence or the tongue will cause a muscular lump to form, which gradually disappears. Miss M. does not show this. The case is very atypical, and yet it is certainly possible that her inability to rise promptly from a chair and to walk off at once, the pain in the muscles of the thighs when she attempts too sudden movement of the lower limbs or when someone suddenly moves the lower limbs, may be dystrophia myotonica. No one in her family has had the characteristic cataract. The omissions of the symptom-complex of this case, the prompt tendon reflexes of the lower limbs, have caused me to study the condition with the possibility of astasia abasia in mind. This is a hysterical condition. Miss M. does not have astasia.

The lumbar spine, sacroiliac region and hips are negative in the roentgen examination. Dr. Orr, an orthopedic surgeon, finds no abnormality of the hip joints. Dr. Keene, by vaginal examination finds nothing abnormal. The disease will progress slowly. There is no cure for myotonia.

Laboratory Examinations.

Roentgen examinations in 1925, by Dr. Jackson, of the sinuses, genitourinary tract, teeth, lower dorsal and lumbar spine were negative, except for the three devitalized teeth. Cystoscopic and pyelographic examinations at Clifton Springs, N. Y., were negative.

Blood and spinal fluid Wassermann tests made on various occasions and in different laboratories were negative.

FIG. 1. Roentgenogram taken in July, 1927. Note the pseudofracture at the lesser trochanter extending towards the shaft, bilateral and symmetrical. This condition was overlooked in first examination at another hospital.

Blood chemistry—urea, uric acid, creatinine, and sugar were normal. Sugar tolerance test negative.

Blood count—no abnormal findings.

Urine examination—sp. gr. 1014, negative for sugar, albumin or casts. No Bence-Jones proteins.

Blood pressure—138/90; later 120/90; pulse 84; temperature 98.2° F.

Patient was referred to Scranton State Hospital, to a special clinic held by Prof. Bauer of Vienna, in March, 1928. After his examination, Prof. Bauer suggested a diagnosis of osteomalacia, based on the peculiar gait (waddling), and pain on pressure over the chest. He referred the patient to the roentgen department for study before presenting her to the clinic. Roentgen examination was made of the chest, thoracic and lumbar spine, pelvis and hip joints. The films revealed no evidence of osteomalacia as generally accepted. Just below the great trochanters of the femurs there appeared bands of increased radioparency that involved the cortex, measuring about 2 mm. in diameter. This transparency apparently divided the bone into two separate parts. In the opposite femur a similar zone of transparency was seen in the identical location, yet there was no displacement (Figs. 1 and 2).

Similar transparency zones with loss of cortical substance were seen in the scapulae, radii, ulnae, metatarsal bones, fibulae, and in the 6th, 7th, 8th, 9th, 10th and 11th ribs (Figs.3 to 8). The 10th rib has a fracture 1 inch from the spinal articulation, symmetrical, and another one about 3 inches away from the spinal articulation, symmetrical. The lesions were multiple and occurred at symmetrical points in the ribs and at right angles to the long axis. The fibulae were involved about 1 inch below the epiphyseal lines.

Fromme considers the point of involvement of those spontaneous pseudofractures to be about 1 inch below the epiphyseal line. In fact, he regards it as a typical localization. The case described follows Fromme's distribution of the site of pseudofractures, yet Simon described a case where the pseudofracture occurred in the middle of the tibia. All the bones involved presented the same type of lesion and there was no evidence of callus formation or other signs of repair. These bone changes may be classified as pseudofractures on account of the fact that there is no separation of the parts, although slight injury may produce complete fracture. Looser reports that the pseudofractures may occur in any bone of the skeleton, and the more severe the disease, the more bones involved, and frequently they occur in a multiple manner in the same bone. The lesion in the bones starts as a small punctate area which gradually encircles the entire cortex. There is no evidence of curvature or deformity of the bones. Looser has also described oblique, transverse and Z-shaped fissures and the widths 10 to 15 mm. The characteristic appearance of the lesion is an area of increased radioparency, the bony architecture appears erased at the point of involvement, the tendency of the lesion to appear below the epiphyseal lines, its symmetry as to location, and the involvement of the bones that are paired. The lesion is also progressive in that it apparently keeps on involving other bones, until, as Looser states, the entire skeleton may be involved.

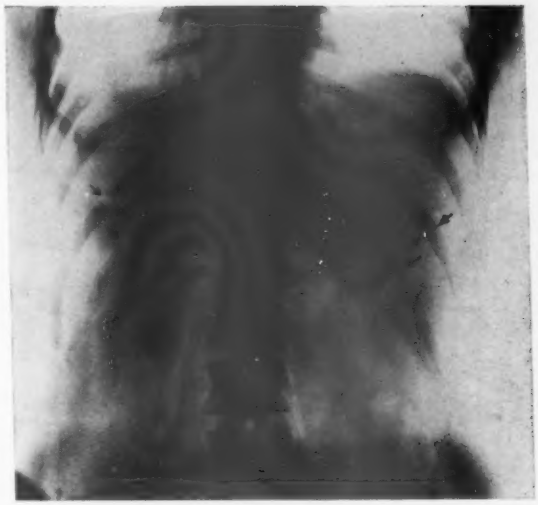

Fig. 3. Tenth and 11th ribs fractured, multiple, symmetrical and bilateral. Note the transparency zones which are characteristic of this lesion.

Fig. 2. The process is much more advanced, extending from the original site in the lesser trochanter and separating the entire shaft, yet alignment of the fragments is perfect; involvement bilateral and symmetrical, even in extent. Note that there is no callus formation—two years later than Figure 1.

The case here reported has been under observation for nearly three years, and in spite of all forms of therapy the process is progressing, although Looser states that callus formation at the site of infraction or

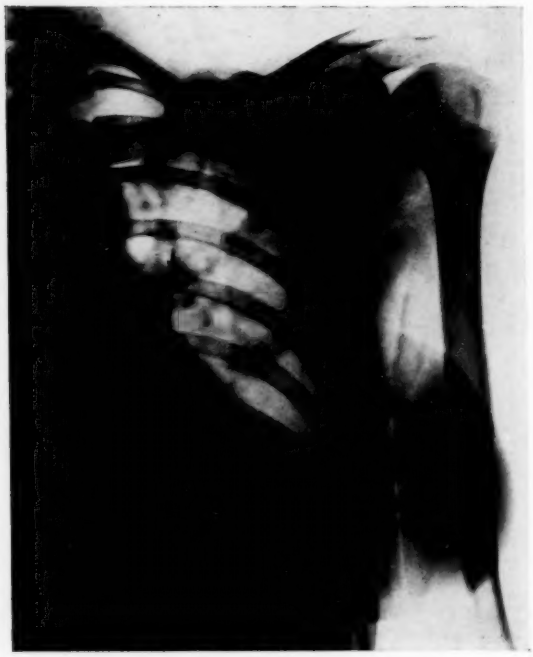

Fig. 4. Transparency zone (pseudofracture) seen in 6th rib, left side. On later films the separation is more marked.

transparency zones is frequently observed, and in healed cases the transparency zones disappear entirely and appear more dense. The striking feature of this bone lesion is that there is no evidence or history of trauma of sufficient force to produce such a multiple type of lesion and that the appearance of the patient contradicts the roentgen findings, also function is only partially interfered with, compared with the multiplicity of changes in the skeleton. Whenever a new site of bone is involved the patient can foretell its location by the tenderness over this area. In fact, pain appears before there are any roentgen signs of bone changes. At present she is having severe pain in both ulnae, and at the next roentgen examination lesions will probably appear there. The roentgen examinations made at intervals show the progress of the lesion.

Following the war there appeared in the German and Austrian literature a variety of conditions affecting the osseous system, which were grouped under the term of "hunger osteopathy". Some could be classified as rickets, others as late rickets, others as juvenile osteomalacia, still others as osteomalacia and senile osteoporosis. The rachitic and late rachitic changes were seen in younger and the osteomalacic changes in older persons. The Viennese cases resembled osteomalacia, with a preponderance in the female sex beyond the menopause. The condition in the patients of Porges and Wagner who were thirty to fifty years old, and in a poor general state, resembled osteomalacia. The cases of Wassermann, Kraus and Citron also had edema. In the cases of Fromme and of Simon, there was a marked preponderance in youth in the male sex. All appear in the final analysis to be the result of the same basic cause, this trauma to the skeletal

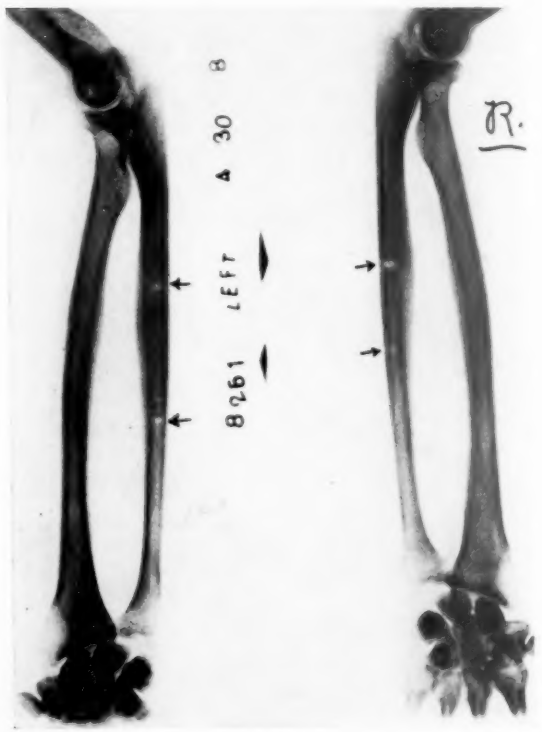

Fig. 5. Transparency zone beginning as punctate area in upper third of right ulna, and a similar process about an inch below involving the cortex. Two areas can also be noted in the left ulna, but not in perfect symmetry with right.

system leading to the rachitic type in males and to the osteomalacic type in females. Looser considers rickets, late rickets, and osteomalacia one and the same condition, differing only in secondary factors due to age, and he classifies all the hunger osteopathies under rickets, late rickets and osteomalacia. Simon could not find proof of the statements of Hocksinger that rachitis tarda always developed on an early rachitis. I could find no history or signs in the skeleton of early rickets in the case presented. The impression obtained from the literature is that the cases in the males resemble rachitis tarda and in the females osteomalacia, except in psychotic old men. Porges, and others, have stated that the CO_2 combining power of the blood is different in true osteomalacia from the osteomalacia associated with pseudofractures. The symptom-complex that most authors are agreed upon is: (1) lumbosacral pain; (2) general weakness; (3) waddle gait; (4) difficulty in raising legs as in climbing stairs; (5) tenderness over the various portions of the skeleton, especially over chest and pelvis; (6) increased patellar reflexes, and (7) skeletal changes resembling osteomalacia or late rickets. Besides the above there are various other phenomena such as edema without definite kidney lesions. In many of the cases the above symptoms, especially in children and young adults, were misinterpreted as rheumatism and in children as growing pains, and were treated for rheumatic affection. The term "growing pains" should always be a danger signal, and there should be a complete physical and roentgen examination, because the health of so many children and young adults has been endangered by this euphonism.

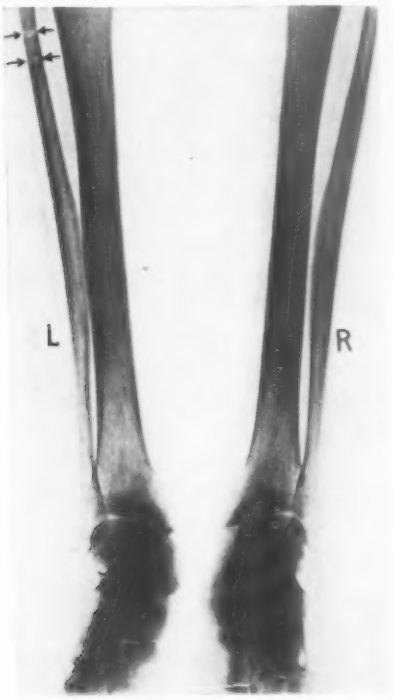

Fig. 6. Transparency zones involving upper end of fibula. The right is as yet not involved. Note the lack of lime salts in the region of the pseudofracture, with no evidence of repair or periosteal reaction.

ETIOLOGY

Most of the European writers on the subject stated that the etiologic factor was lack of food. They also incriminated some or all of the endocrines and finally vitamins. The influenza epidemic of 1918 was considered as a contributory factor by several authors. This patient has not had any insufficiency of food. Careful examination revealed no abnormalities of the endocrine glands, also no deficiency of vitamins in her diet could be discovered, and when she was put on a diet rich in various vitamins there was no improvement. The fact of increased reflex excitability is interesting and important in that it may be regarded as an expression of a lesion of the endocrine system, especially the parathyroids. Schüller, in 1909, during a tetany epidemic in Vienna noted coexisting bone changes which he regarded as rachitis tarda, yet the more recent work of Mendel and Albright showed the lesions produced by a disturbance of the parathyroid gland to be of the cystic type. The case under discussion shows no evidence of bone cyst formation. Added to the above

Fig. 7. Punctate area involving lower third of left ulna. This is characteristic of the beginning of the lesion, which then extends through the entire shaft as though the calcium has been absorbed or cut through.

are various neurologic symptoms and many of them are contradictory, so that one definite entity cannot be diagnosed. Hysteria was frequently associated, especially in young girls, and spasm in the various muscle groups. Schlesinger explains this as a defense mechanism. The disturbance in gait is explained by Schlesinger and Shiff as due to muscle weakness or to paresis of the iliopsoas muscle. Simon thinks it is due to the transformations in the bone, although muscle weakness may help.

A. This condition differs from a osteopsathyrosis or fragilitas ossium in these details: (1) it is not familial; (2) no blue sclerotics; (3) no difficulty in hearing; (4) no evidence of repair; (5) the symmetry of the lesion as to location and degree; (6) lack of deformity; (7) no history of trauma. This condition differs from the type of fragilitas ossium known as osteopetrosis or marble bones, Marmorknochen, Marmorskelett, Albers-Schönberg's disease, diffuse osteosclerosis, etc., in that it shows no evidence of sclerosis of the osseous system, no epiphyseal deformities, physical underdevelopment, hydrocephalus, anemia and other secondary characteristics usually associated with osteopetrosis.

In a review of the literature Hass refers to Lobstein's description of idiopathic osteopsathyrosis in 1825. Later Gurlt, Griffith, Broca, Herbult, Looser, Axhausen, Lipschutz, Matswoka, Eckman, Vonrebbling, etc., all describe and recognize familial and hereditary factors in osteopsathyrosis, and they mention the various familial stigmata mentioned above. Many of their patients were either in their early childhood or adolescence. They do not describe one patient past thirteen years of age.

The patient described in this article does not possess any of the history or stigmata associated with idiopathic osteopsathyrosis.

B. The case differs from multiple myeloma: (1) head shows no evidence of lesions usually seen in multiple myeloma; (2) the character of the lesion is not of the punched-out type as is usual with multiple myeloma; (3) the distribution of the lesion is not typical of multiple myeloma; (4) urine shows no evidence of Bence-Jones proteins. The above differential factors also apply to chloroma, with the added fact that the patient has no leucemia.

C. It differs from malignancy: (1) no primary focus; (2) history and duration. Patient shows no evidence of cachexia; (3) no evidence of invasion of surrounding structures; (4) from a roentgen viewpoint the lesions do not show the characteristics of a lesion due to malignancy.

D. It differs from lues: (1) repeated negative Wassermann reactions; (2) negative history; (3) negative family history; (4) no clinical evidence; (5) roentgenologically syphilis is a sclerosing as well as destructive lesion. This lesion shows no evidence of sclerosis; (6) does not respond to specific treatment.

E. It is not osteogenesis imperfecta: (1) this condition appears soon after birth; (2) bone deformities are usually present in osteogenesis imperfecta, but are not present in the case described; (3) roentgen examination of this patient three and one-half years ago showed no evidence of bone changes or any bone deformities.

F. Peculiar bone changes are found in the insane: (1) this patient shows no signs of insanity; (2) she still is following her profession as school teacher; (3) she has no psychiatric symptoms.

G. Dystrophia myotonica—the diagnosis suggested by Dr. Spiller. All the literature on the subject was abstracted and reviewed for Dr. Spiller, and no mention of any bone changes are reported. This might be due to two reasons: (1) Dystrophia myotonica is a rare condition; (2) the patients may never have been roentgenographed, but it seems hardly plausible that if the patients had complained of any symptoms referable to the osseous system roentgenograms would not have been taken. Dr. Spiller in his report mentioned that the symptoms presented by this patient were atypical of dystrophia myotonica, and that many of the characteristic symptoms were missing.

H. There is no evidence that might suggest inflammatory changes: (1) temperature normal; (2) no leucocytosis; (3) no evidence of local changes usually associated with inflammation.

I. Osteoporosis in exopthalmic goiter: This lesion is systemic and is due to generalized lime salt absorption due to increased calcium metabolism. It resembles osteomalacia. Therefore it differs from the case described in that the patient has no exopthalmic goiter and the bones are of normal density.

Patient has had the following forms of treatment with no result: (1) salicylates; (2) mixed treatment (for lues); (3) phosphorized cod-liver oil; (4) parathyroid extract; (5) adrenalin, hypodermatically; (6) heliotherapy, common and artificial; (7) calcium lactate and a diet rich in calcium salts, especially leafy vegetables; (8) physiotherapy, including high frequency; (9) viosterol. The patient states that aspirin gr. x, t.i.d., gives her most relief and enables her to walk better.

The fact that in the German and Austrian literature the various patients responded to some or all of the above-mentioned treatments, and that some responded to a correction of diet, again suggests that many different types of bone lesions and systemic disorders were grouped under the name of hunger osteopathy, and the fact that some of the patients reported did not suffer from food privation —some came from the country districts where food was plentiful—makes me believe that we have not as yet found out the etiologic factor in this condition.

Fig. 8. A later view of the right forearm showing the process more extensive in the ulna and beginning along the interosseous border in the radius. This shows the progressive character of the lesion, although the patient had been under treatment.

If one accepts Looser's views, then rickets, late rickets and osteomalacia are the progressive representation of the same pathology, and the different symptoms are due mainly to the age period that the skeleton is exposed to insult. Of course I have not been able to make any pathologic sections of the case reported, and therefore I am handicapped in not knowing the actual pathology present. From the character of the lesion, it can be stated that it is of systemic origin involving the centers of bone metabolism, perhaps the blood supply in the particular portion of the bone, especially as this case has shown no tendency to repair. I therefore believe the condition described here forms a definite clinical entity which will become more distinct as bone pathology is better understood, and a definite etiology may be determined.

The reason for reporting this case is that the roentgenograms were shown to many of the prominent roentgenologists throughout the United States, and they apparently were not familiar with the cases reported by the German and Vienna workers, and also there apparently has been no similar cases reported in the American literature.*

* I want to express my sincere thanks to Drs. Pfahler, Pancoast and Pendergrass for their kind assistance, and to Drs. Butzner and McDonnell for permission to use their clinical records.

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ANOMALOUS ENLARGEMENT OF THE LIVER AND A DISSECTING HEMATOMA OF THE PHRENIC NERVE*

CASE REPORT

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THE case here reported was of interest because of two rather unusual conditions found at autopsy, which made clear certain roentgen observations for which no adequate explanation was found during the life of the patient.

The patient was sixteen months of age. She was one of six children, her birth and postnatal development being normal. She had never been sick until the illness which proved fatal.

About three months before admission to the University Hospital, service of Dr. J. Claxton Gittings, she had contracted whooping cough, which was evidently severe but not unusually so. One month before admission she began to run an irregular fever, which her family physician pronounced as the onset of pneumonia. This, he told the family, cleared up one week before admission.

At about the time she was said to be recovered from the pneumonia, she had a severe general convulsion and became stiff and blue. A similar attack occurred the following day. Pharyngitis and diarrhea were noticed at this time, and she was put on a restricted diet. She apparently improved somewhat until the day before admission, when pus began to drain from her right ear and she complained of some pain in the region of her left elbow which was swollen.

On admission she was described as fairly well nourished, markedly toxic and coughing occasionally in paroxysms. In addition to the discharging ear and swollen arm, she was found to have signs of consolidation with diminished breath sounds at the base of the right lung and a liver palpable about 3 cm. below the costal margin. The admission diagnosis was acute otitis media, acute stomatitis, bronchopneumonia with empyema, and diarrhea following parenteral infection.

Laboratory studies showed a definite anemia with reduced hemoglobin and a leucocytosis of 12,700 of which 75 per cent were polymorphonuclear cells. Blood culture showed a heavy growth of hemolytic *Streptococcus pyogenes* at twelve hours.

A roentgenogram of the left elbow did not reveal any disease process in the bones. Roentgen examinations of the chest were of particular interest. The first examination on admission showed at the roentgenoscopic observation

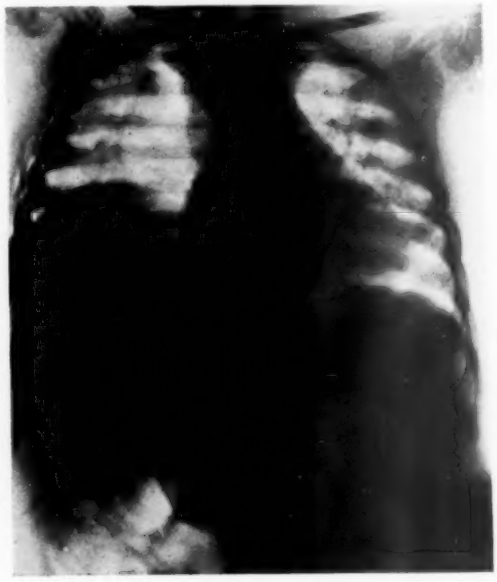

FIG. 1. Anteroposterior view of the chest on admission.

some restriction in the motion of both diaphragms. The roentgenograms in the anteroposterior view (Fig. 1) revealed a diffuse mottling of both lungs with a dense shadow at the right base, which in the lateral view (Fig. 2) gave the characteristic appearance of an interlobar collection between the right middle and lower lobes. The interpretation was a bilateral bronchopneumonia with an interlobar collection between the right middle and lower lobes.

* From the Departments of Roentgenology and Pathology, University of Pennsylvania, Philadelphia, Pa. Read before the Philadelphia Roentgen Ray Society, Nov. 7, 1929.

The possibility of a liver abscess was also considered. A thoracentesis was attempted but only a few cubic centimeters of bloody fluid could be secured. A second roentgen examination was made five days later. At the roentgenoscopic examination there was noted a typical paradoxical movement of the right diaphragm indicating a paralysis of the right phrenic nerve. The appearance on the roentgenograms was much the same as at the first examination. There was some increase in the pneumonic process in both lungs while the shadow at the right base in the lateral view was even more characteristic of an interlobar collection.

The treatment consisted largely of fluids and transfusions. In the six days that the patient was in the hospital she received 635 c.c. of citrated blood in five transfusions and several subcutaneous injections of normal salt solution. After the last transfusion, she had a normal red cell count and almost normal hemoglobin.

The course in the hospital was progressively downhill, with a temperature which was persistently elevated, ranging from 104–106° F., and a cough which was annoying and unabated.

The day following the last roentgen examination of the chest the patient's condition became markedly worse and she died.

At autopsy, the few positive findings were as follows:

(1) Small puncture wounds, evidently made by transfusion needles, in the antecubital spaces, and in the neck along both sternomastoid muscles.

(2) Bronchopneumonia in the right lower lobe, with no evidence of previous or present pleural exudate. There were no pleural adhesions.

(3) A high right dome of the diaphragm, rising to about the level of the second interspace anteriorly. The muscle was of the same thickness as the left dome, and was apparently normal.

(4) Upon exposure, the liver was found to be much enlarged, particularly on the right side, so that some pathology was suspected. There was no subdiaphragmatic exudate or adhesions, and the rest of the surface of the organ was perfectly smooth and normal. Upon cutting the organ, it was found to consist of apparently normal liver tissue throughout, and this later proved to be so by microscopic examination. The right lobe was about 15 cm. thick.

(5) The spleen and kidneys showed the customary changes found in an overwhelming blood stream infection.

(6) Under the pleura, on the right side of the mediastinum, a liquefying hematoma was seen, extending down the course of the large veins, involving the right phrenic nerve, both by surrounding it and by distending the tissues in which it lay. This hemorrhage had forced its way into the thymus, and could be traced up to the sites of the transfusion. On lifting the skin on the other side of the neck, a small subcutaneous hematoma was found lying over the inner end of the left clavicle.

The pathological diagnoses were: cause of death: septicemia; underlying causes: bronchopneumonia; acute embolic nephritis; otitis media.

Coincidental findings: dissecting hematoma about the right phrenic nerve; anomalous enlargement of the right lobe of the liver.

It is the last two of these findings to which we wish to call special attention. Taking them in order, it will be recalled that at the last roentgenoscopic examination paradoxical movement of the dia-

Fig. 2. Right lateral view showing a shadow at the base simulating an interlobar collection of fluid between the right middle and lower lobes.

phragm was observed on the right side. This was undoubtedly due to paralysis of the right phrenic nerve occasioned by the dissecting hematoma. One has but to re-

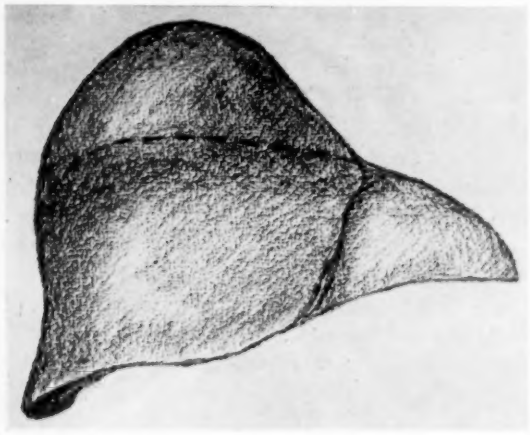

Fig. 3. Drawing made of the liver removed at autopsy. The broken line indicates the approximate position of the superior surface of a normal liver.

call the intimate relation between the internal jugular vein and the phrenic nerve in the neck to understand the manner in which extravasated blood from the internal jugular vein might readily find its way along the phrenic nerve and thus by pressure cause considerable damage, at least functionally. That this extravasation of blood may occur even under the best of care, and with good technique, should be understood. That this occurrence is not more frequently encountered is probably due to the fact that paralysis of one phrenic nerve is not usually accompanied by physical signs or symptoms. Thus its detection would depend largely upon roentgenoscopic examination as in the case here presented.

Of equal practical importance is the knowledge that anomalies of form of the liver occur, there being no pathological change in the tissue or its function. Most of these anomalies of the liver are probably carried about undiagnosed, in fact unsuspected, only coming into prominence when they confuse diagnosis in some entirely unrelated disease. The drawing (Fig. 3) gives a comparison of this liver with the normal.

They are for the most part congenital, and therefore may be seen at any age. Formerly, much stress was laid on the deformation of livers by tight lacing and wasp-waist corsets, the pathologists of fifty years ago mentioning these forms specifically. It seems to be generally accepted now that these unusual markings have little or no connection with the styles, but represent congenital irregularities of development.

The roentgen diagnosis of a collection of pus in the interlobar fissure made primarily on the lateral films, resulted from a shadow caused by the overlapping of the heart, and the high right lobe of the liver. Back of the heart an area of lesser density may be seen on close examination, representing the liver, with overlying lung. This shadow was so far above the upper limit of the normal liver that this organ was not considered when the film was viewed.

As to the relative frequency of anomalies of lobulation in the adult liver, there are unfortunately few figures or authoritative statements available, either in textbooks or in the recent literature. In discussing the formation of the liver, Piersol says in part, "One peculiar form of liver occasionally met with shows great increase of the right lobe, particularly in a vertical direction, with want of development of the left lobe, which is thin and short." This, certainly, is an anatomist's description of the condition found in our subject, but gives little hint of how frequently we may expect it to be found.

One of the popular texts on pediatrics, that of Holt and Howland, takes no note of abnormal form of the liver, except where there has been anomalous development of the fetus as a whole.

The exhaustive work in pathology by Kauffmann, recently translated into English

by Reimann, makes the statement that "abnormal lobulation is not rare."

H. E. MacMahon in a recent article upon anomalies of the liver is most concerned with unusual development of portal and biliary systems. He considers abnormalities of the liver uncommon, and anomalies of size as relatively rare.

So we are forced to conclude that no definite figures are available, but that enlargement of the right lobe such as was seen in our subject is not unknown, at least to a lesser degree. How frequently one may expect to encounter this condition in everyday experience is problematical.

Thus it is seen that this case presented two unusually interesting features. The anomalous enlargement of the liver is probably of such rare occurence as to be of little clinical importance. The possibility, however, of a paralysis of the diaphragm as a complication in the use of the jugular veins for the purpose of transfusion affords knowledge of distinct clinical value.

THE REACTION OF LYMPHOID TISSUE TO ROENTGEN RADIATION

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ROENTGEN radiation has become more and more serviceable in its medical application and the experimental study of its effects upon tissue has also become more systematic. The use of radiation in the diagnosis and cure of various diseases is almost at its height; its application in the treatment of diseases of the lymphoid tissues seems a practical therapeutic measure. However, the study of the histological changes caused by this radiation is not yet complete.

Heineke, in his experiments, noted the results of irradiation upon the viscera of mice, guinea pigs and rabbits. In the lymph nodes he found changes beginning two and three hours after irradiation, becoming more marked at six to eight hours, and reaching their height at twenty-four hours. Thirty-six hours after irradiation the tissue reaction is completed. In these experiments no quantitative relationships were noted. In 1920, Nakahara and Murphy studied the effects of small doses of roentgen rays on lymphoid tissues. Using a fixed amount of radiation they noted the appearance of mitoses in the spleen and lymph nodes, and interpreted this evidence of lymphoid proliferation as being due to the hyperactivity of the lymphoblastic tissue. Jolly, in 1924, exposed the popliteal regions of rabbits to a fixed amount of radiation and studied the changes in the popliteal lymph nodes as compared with changes in the bone marrow and spleen. Those in the lymph nodes appear very early, while those in the spleen and bone marrow are much later; likewise the regeneration in the lymph nodes is much quicker than in the other two organs. The above authors all agree that radiation causes a destruction of the lymphoid cells soon after exposure.

Since in the literature very little mention is made of the relation between the amount of radiation and the reaction in the lymph nodes, we have undertaken the study of this relation. For experimental animals we used rabbits, weighing about 2 kilos each. Irradiation was carried out under the following conditions: An "H" type Coolidge tube was used. Spark gap 37 cm.; filtration, 0.5 mm. zinc plus 0.3 mm. aluminum; size of irradiation field, 36 sq. mm.; secondary current, 1.6 ma.; distance, 35 cm.; length of shortest wave 0.08 Å.

One knee of each rabbit was irradiated and the other knee was used as a control. Four series of exposures were made; one with 1/3 S.U.D.; one with 1/2 S.U.D.; one with 1 S.U.D., and one with 2 S.U.D. The animals were then killed at various periods of from thirty minutes to as long as three weeks after irradiation. In still another series of animals we studied the effect of continuous irradiation in which a knee on one side was exposed to 1/2 S.U.D. once a day for five days and in another series once a day for ten days. All of the irradiations were done on the left knee using the right for a control.

Results. The popliteal lymph nodes of an unirradiated rabbit are about the size of a small pea, fairly firm in consistency and grayish in color. Microscopically the capsule is very thin and within it are seen the lymph follicles; between these germinal centers run the sinuses which join to form the hilus. The bulk of the gland, especially around the follicles, is made up of lymphocytes. In the germinal centers are seen larger cells which are polygonal; occasional mitoses are seen here, or a cell containing eosinophilic granules. Around these cortical lymph

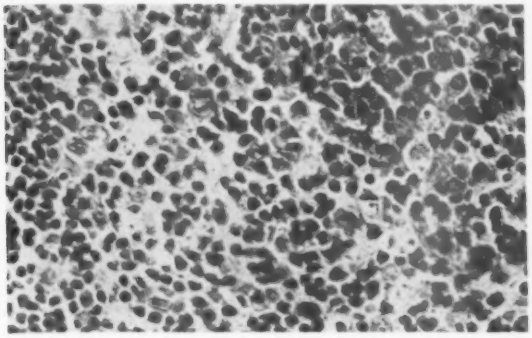

Fig. 1. Lymph node seven days after exposure to a small roentgen dose (1/3 s.u.d.). There is some increase in connective tissue. An occasional phagocyte is seen.

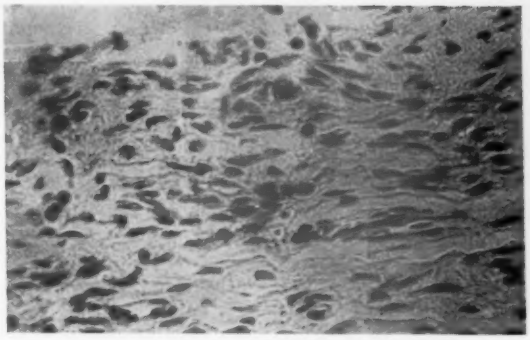

Fig. 2. Lymph node two weeks after exposure to one medium roentgen dose (1/2 s.u.d.). Marked fibrosis of the gland.

follicles run very fine lymph sinuses which accompany the trabeculae of the node as they approach the hilus. Here the sinuses are much larger, are lined with their usual endothelial cells and are separated from one another by masses of lymphocytes here known as medullary cords. In addition to the lymphocytes there are also seen occasional eosinophlic mononuclear cells. Emerging from the hilus along with the lymphatics are several small blood vessels.

Thirty minutes after exposure to the smallest amount (1/3 s.u.d.) of radiation, we note that the cells in the lymph follicles and especially in the germinal centers are enlarged. After one hour the nuclei of many of these cells begin to show disintegration which reaches its height in from two to six hours. From this time on marked phagocytosis is noted, the phagocytes taking up the chromatin particles of the decomposed nuclei. At the same time mitotic figures are noted among these cells. Six hours after irradiation there appears some clearing up of the decomposed tissue, due to the above mentioned phagocytosis, and this function almost ceases after forty-eight hours, although slight evidence of it may remain for five days. Due to this disintegration of lymphocytes there is a marked decrease in the number of these cells in the lymph follicles at forty-eight hours. From now on there is a period of regeneration so that after the seventh day the lymph gland is back to normal except for a slight increase in the connective tissue (Fig. 1). If the gland on the opposite side, which was not irradiated, is now examined, one finds at the one hour period a slight increase in the number of mitotic figures. At the second hour there is some disintegration of the cells in the lymph follicles. Phagocytosis is definitely present at twenty-four hours and the condition of decomposition in the lymph node can be recognized up to the tenth day and returns to normal only after two weeks.

In the next series of experiments, using a moderate degree, 1/2 s.u.d., of radiation, phagocytes are seen in the lymph follicles at thirty minutes; at one hour there is disintegration of nuclei of cells in the follicles; at two hours this decomposition is marked and reaches its height at the sixth hour. By the twelfth hour the phagocytes have cleared up most of the nuclear fragments, accompanying which there is great decrease in the number of lymphocytes. At forty-eight hours the phagocytes are no longer present and mitoses are regularly seen. From then on there is regeneration and at the end of the third week all that remains as evidence of this irradiation is an increase in the connective tissue in the lymph node (Fig. 2). Macroscopically there is an increase in the lymph gland after two hours which

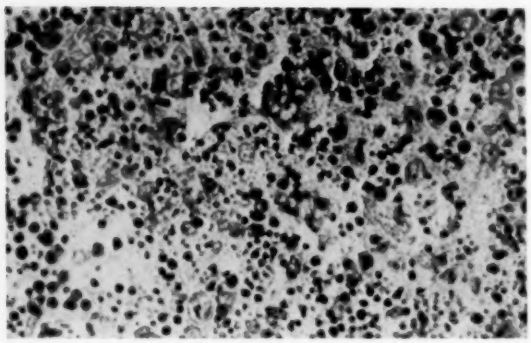

FIG. 3. Lymph node six hours after exposure to a larger roentgen dose (1 S.U.D.), showing decomposition of the gland.

then decreases so that from the first to the second week it is smaller than normal and by the third week it has resumed its normal size. On the control side, the changes seen after a moderate dose are the same as those seen after a small dose of radiation, namely, an increase in the mitotic figures and phagocytes after one hour, with decomposition up to the sixth

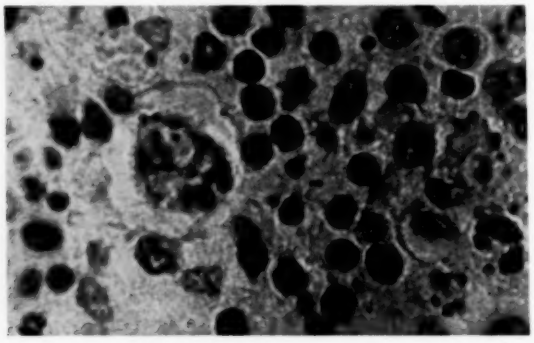

FIG. 4. The same as Figure 3, but higher power. Many phagocytes are seen.

hour. At the twelfth hour there is a marked increase in the mitoses. From the third day on there is an increase in connective tissue; at the tenth day hardly any mitotic figures are seen, but disintegration of the nuclei reappears with phagocytosis. At the end of the third week there is much more fibrosis. The end-result then parallels the difference in degree of radiation.

In the third series, a large amount of radiation, 1 S.U.D., was used. At thirty minutes there is marked degeneration of the lymph follicles accompanied by increased activity of the endothelial cells. This decomposition reaches its height at the sixth hour when one sees in addition eosinophilic cells and what appears to be an exudate (Figs. 3, 4 and 5). From now on until the twenty-fourth hour there is very active phagocytosis of the nuclear fragments. From the forty-eighth hour this activity slows down and ceases on the

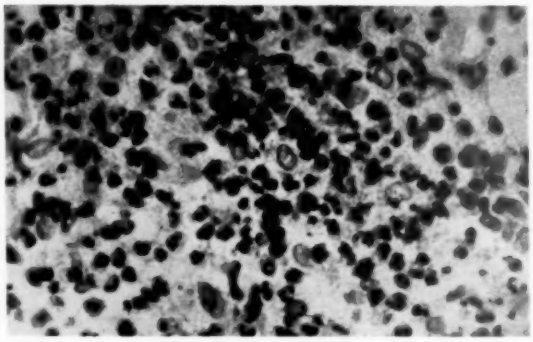

FIG. 5. The same as Figure 3.

fifth to seventh days. From now on there is proliferation of connective tissue up to the third week (Figs. 6 and 7). On the control side with the large amount of radiation you see an increase in mitoses at one hour and at the second hour a large number of phagocytes. Decomposition appears later, from the sixth to the forty-eighth hour, accompanied by marked phagocytosis, all of which disappears by the seventh day.

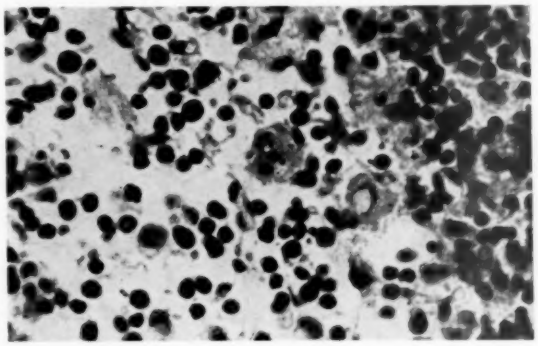

FIG. 6. Ten days after one exposure to a large roentgen dose (1 S.U.D.). There is a decrease in the germinal centers and an increase in the connective tissue.

In still another series of animals a maximum dose of radiation was used, 2 S.U.D. Disintegration appears at one hour, accompanied by endothelial activity and the presence of eosinophile cells; this reaches its height at six hours (Figs. 8 and 9). Phagocytosis then appears and seems to reach its height at twelve hours. At the twenty-fourth hour one notes the greatest dearth of lymphocytes and at this same

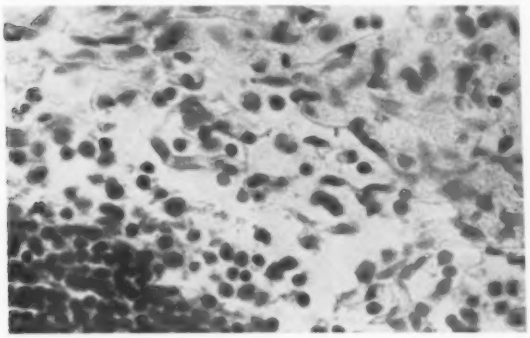

FIG. 7. Lymph node three weeks after exposure to 1 S.U.D.

time most of the cellular débris has been cleared away. After the forty-eighth hour no more phagocytes are seen; regeneration then sets in, and from the fifth day on an increase in the connective tissue is noted. In this and the preceding series (where 2 and 1 S.U.D. were used respectively), no increase in the number of mitotic figures was seen until after the second week. On the control side mitoses

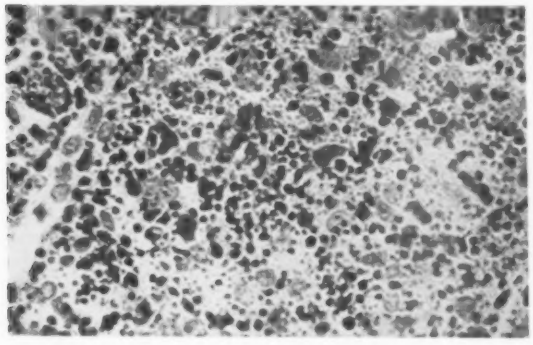

FIG. 8. Lymph node six hours after exposure to maximum roentgen dose (2 S.U.D.). There is marked decomposition and activity of the endothelial cells.

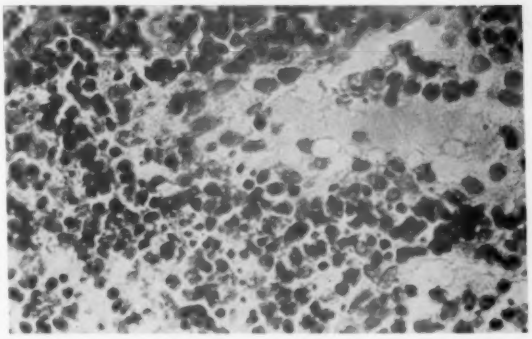

FIG. 9. Six hours after exposure to 2 S.U.D., showing exudation into lymph sinus.

are seen at the sixth hour, but cellular disintegration and phagocytosis appear very late and are not marked. The end-result is a fibrosis similar to that seen on the irradiated side.

In two other series of animals a moderate amount of radiation was given daily for five and ten days respectively; the results were the same except that in the latter

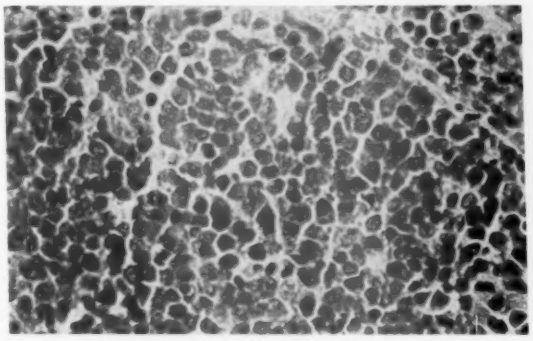

FIG. 10. Gland from control side three weeks after a course of five daily exposures to a medium roentgen dose. Occasional mitoses are seen.

series they were more marked. Twenty-four hours after the completion of repeated doses of roentgen rays there is a decrease in the number of lymphocytes, followed by fibrosis of the gland which is complete in two or three weeks. On the control side there is at first very little disintegration and phagocytosis; mitoses, however, are much more numerous and remain so up to the third week after the course of irradiation (Figs. 10, 11 and 12).

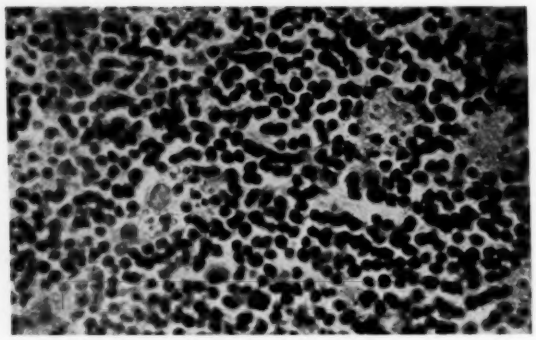

Fig. 11. Gland from control side two weeks after a course of ten daily exposures to a medium roentgen dose. Phagocytic cells are not infrequent.

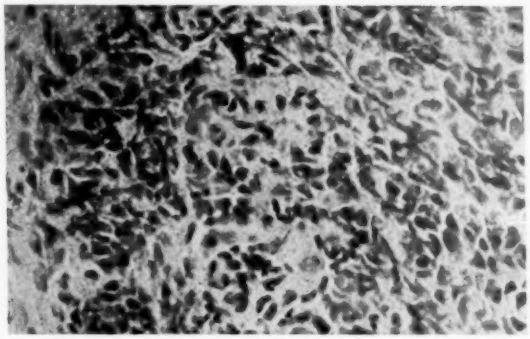

Fig. 12. Exposed lymph node three weeks after a course of ten daily exposures to a medium dose. Marked fibrosis is seen.

CONCLUSIONS

1. The reaction of lymphoid tissue to radiation, as demonstrated in the popliteal lymph node of a rabbit, can be divided into three periods: an early period consisting of the first twelve hours, a middle period extending from twelve hours to five days, and a late period following the fifth day.

2. In the early period are noted increase in size of the lymph node, nuclear disintegration and decomposition of the germinal centers. Accompanying this some of the phenomena of inflammation are seen,—cellular infiltration, congestion and exudation. Mitoses are seen during this period only when a small dose of roentgen rays is used. This evidence of regeneration is not present when the large dose is used.

3. The middle interval is devoted mainly to phagocytosis and the clearing up of cellular débris.

4. At the late stage there is fibrosis of the lymph node.

5. The degree and rapidity of these above-mentioned phenomena are in proportion to the dose used.

6. On the control side the reaction is much less and much slower than on the irradiated side, although otherwise it is the same.

Vol. XXIV, No. 1

COMPLICATIONS IN THE URINARY TRACT DUE TO CARCINOMA OF THE UTERINE CERVIX OR RADIATION TREATMENT*

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CARCINOMATA of the uterine cervix may involve the urinary tract by compression, infection or invasion of either the bladder or the ureter. Radiation treatment of cervical carcinomata has apparently contributed to an increase in the frequency of urinary tract complications. Whether the primary, the secondary and the tertiary or late complications after radiation therapy result from the ravages of the carcinoma or from the action of the rays on the tissues within the field of irradiation can only be determined by a routine examination of the urinary system at the time of admission of the patient. Involvement found at this time should be attributed to the growing and invading tendencies of the malignant growths. If complications occur after the application of radiation then they may be caused by the action of the rays or result from a continuation of the destructive tendencies of a carcinoma which had not been arrested in its activities by the treatment.

Changes in the tissues caused by irradiation are characteristic and hence when exposed to view by cystoscopy, autopsy and microscopy should settle any doubt about the underlying cause of the urinary tract disturbances. Complications in the urinary tract are of frequent occurrence, cause severe symptoms, tend to chronicity and hence have become important clinical problems. A study of the underlying causes, the clinical manifestations and treatment will form the subject matter of this paper.

COMPLICATIONS IN THE URETER AND KIDNEY

Complications arising in the upper urinary tract have been discussed by Chavannaz[4] in 1899 and Gauss[6] in 1904. They investigated anuria and its causes in the course of cervical carcinomata. Hunner[13] in 1918 considered ureteral stricture in all its phases. He considers intrinsic inflammatory changes the chief etiological factors.

In 1920 I[20] reported an autopsy on a patient who had been treated with radium in March, 1915, for a clinical group 2 adenocarcinoma of the cervical stump. The total dose applied was 3500 mg-el-hr.; the amount used was 50 mg. element, filtered with 1.5 mm. brass and 3 mm. pararubber. The radium capsule was inserted into the cervical canal three times for about twenty-four hours at each application, at an interval of eight days. In December, 1916, the patient returned complaining of pain in the left lower abdomen and the deep muscles of the hip and a gradually increasing difficulty in evacuation of the bowels. Examination revealed a healed cervix and a hard contracted parametrium which compressed the rectum. Urinary tract disturbances were not suspected. The patient died on March 10, 1927. Postmortem examination revealed an almost total obstruction of the rectum, a total obstruction of the left ureter, with an enormous hydro-ureter nephrosis and a partial obstruction of the right ureter with a moderate distention of right ureter and kidney pelvis. Serial microscopic examination of all the pelvic tissues did not reveal any nests of carcinoma cells. The conclusions reached were: (1) that the urinary tract complications resulted from scar tissue formation in the parametrium due to progressive fibrosis fromradium irradiation,

* From the Departments of Gynecology, Loyola University School of Medicine, Mercy and Cook County Hospitals, Chicago, Ill. Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8–9, 1929.

and (2) that routine examinations of the urinary tract and rectum should be made before and after radium applications and at the appearance of pelvic pain.

Herger and Schreiner[12] performed 32 autopsies and investigated the condition of the bladder, ureters and kidneys in patients with cancer of the uterine cervix. Twenty-one patients showed gross pathological changes in the urinary organs. They then studied clinically 50 cases of advanced carcinomas of the cervix to determine the frequency of urinary tract lesions. On cystoscopic examination 14 cases showed definite ulceration and infiltration of the bladder mucosa in the region of the trigone. The remaining patients had elevation of the bladder wall in the same area. Ureteral catheterization and pyelography revealed obstruction with hydronephrosis in 24 cases. The authors do not state whether irradiation had been given prior to the urinary tract examinations, but conclude that the strictures resulted from pressure on the ureter due to invasion of the broad ligament or bladder wall, possibly made worse by the fibrosis resulting from radiation therapy.

Thibaudeau[26] reported suggestive findings revealed at autopsy in 300 patients treated by irradiation for the most part for malignancy. There were 80 carcinomas of the pelvic organs, 27 in males and 53 in females, with a total of 15 hydronephroses, or about 18.75 per cent. He concludes that hydronephrosis is a very common complication of malignancies in the pelvis. It occurs in both irradiated and non-irradiated patients. Albano[1] also discussed the same subject.

Götting,[7] in 1923, reported a case of anuria in a patient who had been treated with roentgen rays for a recurrence of a cervical carcinoma three years after a Wertheim operation. Autopsy confirmed the clinical diagnosis of occluded right ureter and patent left ureter with reflex anuria of the left kidney. Matusovszky[18] states that one of the most disagreeable complications of radium-roentgen therapy is anuria from ureter compression due to shrinking processes in the parametria. He cites Simmonds who claims that pyelonephritis is the cause of death in 5 per cent of cervical cancers, and Busse, who found disturbances of the urinary tract without injury to the ureters after panhysterectomy in 50 per cent and pyelitis and pyelonephritis in 25 per cent of the patients. Matusovszky reports a case of anuria after radium application lasting six days. It was successfully treated with indwelling catheters.

Martin and Rogers[15] in animal experimentation found that a radium dose of 75 mg-el-hr. placed alongside the ureter will cause complete constriction, while 50 mg-el-hr. will cause a partial constriction. The procedure of blindly inserting radium needles or radon seeds into the paracervical tissues is hazardous as the ureters may become obstructed. Transplantation of the ureters or ureterostomy should render the implantation plan of attack relatively safe. Martin[16] in a later contribution describes the symptoms and treatment of ureteral obstruction. The prophylaxis consists in a proper irradiation technique. Stress is laid on a broad ligament roentgen irradiation, which frequently abates ureteral obstruction. Dilatation of ureter, indwelling catheter, ureteral transplantation, ureterostomy and nephrostomy are the other methods advised for the relief of these conditions.

CLINICAL DISCUSSION

Complications in the ureter and kidney may be produced in three ways: (1) Infections, such as cystitis, pyometra, tuboovarian abscess, para- and perimetritis may by ascension and direct extension cause ureteritis, pyelitis, pyonephritis and pyonephrosis. (2) Irradiation may compress or obliterate the lumen of the ureter. Compression may result from scar tissue formation in the parametria, while occlusion may be caused by the insertion of radium nee-

dles or gold filtered radon seeds in the paracervical connective tissue. The result will be hydro-ureter and hydronephrosis and, if infection ensues, pyelitis and pyelonephritis. (3) The carcinoma, if still active, may invade the ureteral wall. Such a condition is rare but many authentic instances have been reported. An active carcinoma involving the parametrium may by compression from without cause ureteral stricture with hydro-ureter and hydronephrosis, and, if an infection coexists, pyelitis and pyelonephritis.

The onset of ureter and kidney complications varies, depending on the existence of infection or cancer compression at the time of admission of the patient, or on faulty irradiation technique, or on fibrotic changes in the parametrium caused by radium. If the complication is caused by a local action of the rays on the ureter, then the symptoms will appear soon after treatment; if it results from fibrosis then months and years may pass; if it results from an infection actuated by the local instrumental manipulation incident to radiation therapy, then the onset takes place almost immediately and often during the treatment.

The symptoms are a constant dull and often acute pain in the affected side. It is usually referred to the loin, or to the pelvis, or to the site of obstruction and trauma or to the sacroiliac synchondrosis. The pain radiates outward into the muscles of the buttocks, downward into the thigh, simulating a sciatica, and upwards to the region of the kidney. Nausea and vomiting may be observed. Disturbances of urination are usually lacking. If infection coexists the patient may experience an initial rigor, pyrexia, anorexia and prostration. The examination of the urine is negative, unless cystitis, ureteritis or pyelitis is present. The urine then is cloudy, contains pus and blood corpuscles and albumin. Examination of the blood reveals a leucocytosis and neutrophilia. The erythrocyte sedimentation test[23] cannot help in the diagnosis as the sedimentation time is almost invariably accelerated in patients suffering from carcinoma.

Ureteral catheterization and pyelography render the diagnosis positive. The insertion of a ureteral bulb bougie into the ureter and the elicitation of a "hang" on withdrawal is pathognomonic for stricture but is absent in obstruction due to compression.

The differential diagnosis should include pyometra, tubo-ovarian abscess, pelvic peritonitis and cellulitis, metastases in the spine, pelvic bones and liver and sacroiliac arthritis.

The treatment should be prophylactic, palliative and curative. Prophylaxis consists in avoiding (1) over-irradiation or repetition of a complete series of irradiation at too early a time; (2) implantation of radium needles and radon seeds unless catheters have been placed in the ureters and the latter are then palpable, and (3) placing radium capsules in the vaginal vaults unless they are highly filtered and maintained at a definite distance by the use of phantoms prepared from cork or bakelite.[22] Dean[5] states that 3500 mg-el-hr. should be considered as bordering on the upper limit of safety. We recommend the intracervical application of 50 mg. radium element filtered with 1.5 mm. brass and 3 mm. pararubber in three interval applications of twenty-four to thirty hours every eight to tenth day. The rectum and bladder must be protected by firmly distending the vaginal canal with gauze sponges. The rectum and bladder should be kept empty by catharsis, enemas and retention catheters. To the radium dose, a roentgen dose of 600 to 800 r may be added to insure a proper radiation dose at the bony periphery of the pelvis, the site of the regional lymph nodes.

If infections of the bladder, the uterus and the adnexa are present, then they must be treated and healed first before irradiation is begun. Normal temperature, normal leucocyte count, absence of pelvic pain when the cervical cancer is still movable,

and a negative virulence test according to Ruge-Philipp[3] are the criteria by which an absence of a complicating infection may be determined.

Dilatation from the vesical approach is the ideal treatment. If the structure is bilateral then one side only should be dilated at a time. The dilatation should be done gently and gradually. It should not be repeated before a lapse of ten days or until the traumatic edema has subsided. If an infection coexists then lavage of the pelvis through an indwelling catheter with a 1:2000 solution of silver nitrate is recommended. The internal administration of salol, urotropin, acriflavin, or caprokol is of value. The symptoms of obstruction and infection may be entirely cleared up under such treatment. In other cases with infection and large kidney pelvis one may not be able to combat the infection and obstruction entirely but may restore the patient to apparent health.

If all methods of conservative treatment have failed, and if the carcinoma has been definitely arrested or controlled by the irradiation, then operation is indicated. The choice of operation depends on the circumstances presented and may be extirpation, pyelotomy, or ureteral transplantation.

COMPLICATIONS IN THE BLADDER

In irradiation of the pelvic organs a more or less intense radiation dose is applied to the urinary bladder. Reactions in the bladder wall are caused by either too high a dose or an idiosyncrasy of the patient. As stated in the beginning paragraph, invasion of the bladder by an extension of a cervical carcinoma is of frequent occurrence. Beckmann found vesico-vaginal fistulae in about 15 per cent, fecal fistulae in 6 per cent, and recto-vesico-vaginal fistulae in about 3 per cent. Zangemeister[27] in 1901 discussed the changes in the bladder associated with cervical carcinomata. Gouverneur and Fabre[8] examined routinely the bladder in 200 cases of cervical carcinoma before and after radium application. Injury to the bladder by radium is negligible. If an inflammation existed before the beginning of radiation treatment then an increase in the symptoms, namely, tenesmus and pollakiuria, should be expected. If ulcers are present in the bladder wall extreme caution should be used in applying radium. They did not see a single vesico-vaginal fistula.

Marzetti[17] states that the most frequent cystoscopic finding is elevation of the bladder floor, the "bombement" of the French. The mucosa is found intact if the cancer has not as yet invaded the bladder wall. In advanced cervical carcinomas punctiform hemorrhages, dilated blood vessels, and reddening of the mucosa are seen. The development of bullous edema means cancer invasion and contraindicates surgical treatment. The terminal changes in the bladder in their sequence are formation of nodules, papillary proliferations, small ulcerations, coalescence of these to form a large ulcer, loss of tissue by necrosis and finally vesico-vaginal fistula.

The changes observed in the bladder after radiation therapy of cervical carcinomata have been discussed by the writer,[21] Heimann,[11] Dean,[5] and others. Dean divides the reactions into: (1) a primary erythema occurring within twenty-four hours; (2) a secondary erythema seen approximately from twenty-one to twenty-eight days later which is caused by a temporary vasomotor paralysis, and (3) a tertiary reaction, which is a late complication and rarely seen before the lapse of one year. He cites 3 cases of bladder ulcers occurring fourteen and a half to twenty-four months after irradiation. The symptoms were frequent and painful urination, especially at the end of the act, and presence of blood in the urine. There may be an offensive odor to the urine. The cystoscopic examination revealed an ulceration of the posterior wall usually beginning just above the trigone. The surrounding mucosa is acutely inflamed. There is a suggestion of a contractural

area in the periphery of the ulcer. The ulcer is impregnated with a gritty deposit. Microscopic examination of the tissue is necessary to differentiate it from cancer. The author states that 3500 mg-el-hr. of radium applied intracervically should be considered a dose bordering on the upper limit of safety.

Schugt[24] reports a case of vesical hemorrhage after radium and roentgen irradiation. The patient had benign uterine hemorrhages for which she received a roentgen castration dose. The hemorrhages did not cease and two months later an intrauterine radium application was made without any benefit, and one year later a second roentgen castration dose was given. The hemorrhages, however, continued. Cystoscopy revealed a nodule in the fundus the size of a pea. A histological examination showed a varix or telangiectasis, which was attributed to the irradiation. Apparently cystoscopic examinations made before this would have proved this contention. Auvray[2] saw a patient who had a squamous cell cancer of the cervical stump which was treated with a pallisade of 800 mg-el-hr. of unfiltered radium in the paracervicum, with 1440 mg-el-hr. of filtered radium intracervically and with a roentgen dose of 2000 R (Solomon). Eight weeks later a vesico-vaginal fistula had formed. Five years later the patient was found free from carcinoma and the fistula was successfully closed surgically.

Ottow[19] reports a case treated with roentgen rays. Six months afterwards an ulcer formed in the abdominal wall which gradually extended deeper and wider. Necrosis caused loss of tissue in the abdominal wall, then sequestration of part of the pubic bone, and finally nine years later a fistula in the vortex of the bladder. Heidler[10] warns against the dangers of prophylactic radium irradiation after a Wertheim operation. He reports a case that was treated with 4000 mg-el-hr. Eight months later a recto-vaginal fistula had formed and nine years afterwards a recto-vesical fistula appeared. Handorn[9] reports two cases of late bladder ulcers nine and a half months and one and a half years after radium treatment. The doses applied were four times as large as used in this country for similar pathology. Stacy,[25] also, describes the late occurrence of trophic ulcers of the bladder. Schmitz and Laibe, in a recent paper, have discussed the clinical and diagnostic aspects of urinary tract complications in pelvic carcinomata treated with irradiation.

CLINICAL DISCUSSION

Irradiation cystitis, the secondary erythema of Dean, usually appears from twenty-one to twenty-eight days after treatment. It is characterized by painful and frequent urination and a feeling of dull burning pain in the region of the bladder. Cystoscopic examination reveals a generalized edema and a deep red discoloration of the vesical mucous membrane. Tolerance of the bladder is decreased.

Irradiation cystitis depends on the total radiation dose given. It increases in severity with an increase in the dose applied. If pathological changes were present before irradiation, then the tissues offer a lessened resistance to the action of the rays and the resulting irradiation cystitis is correspondingly severe. If the bladder is diseased then it should be treated first before irradiation is applied. Carcinomatous invasion of the bladder from a cervical carcinoma contraindicates radium treatment; roentgen rays, however, may be used.

The cystitis is treated by lavage with boric acid solution until the washings return clear. Hyoscyamus, sodium citrate, lithium benzoate, lithium citrate are given internally. The condition is self-limited and subsides with conservative treatment within three to six weeks.

The late complications in the bladder after radiation therapy, the tertiary reactions of Dean, rarely occur before one to two years. They correspond to the irradiation indurations seen in the skin exposed to rays. The same dose may safely be applied

to a large number of patients; yet here and there a patient will show latent tissue indurations. If the irradiation technique was perfect one must assume that such patients possess a lessened resistance to the rays, a true idiosyncrasy.

The onset is insidious. The patient may be aware of a sense of tightness in the depth of the pelvis. Gradually discomfort is felt on urination. It increases in intensity until dysuria and pollakiuria are extreme. The urine may contain blood, gritty deposits and tissue shreds depending entirely on the degree of development of the irradiation induration into an irradiation ulcer.

Cystoscopic examination reveals a glistening white mucosa with fissures and with a sparse supply of blood vessels. The posterior bladder wall has lost its elasticity; it is scarred, firmly fixed to the uterus, streaked with telangiectases. Small indolent ulcers may be seen covered with urinary salts. The tolerance of the bladder is decreased because the posterior bladder wall cannot slacken, it is firmly adherent to the adjacent organs and is fibrous. As time goes on the small ulcers increase in size, necrosis takes place, and as a terminal step, sloughing of the indurated area with the formation of fistula renders the picture complete. It is the same process seen in the skin: induration with telangiectasis, ulceration, necrosis, sloughing.

Should similar changes occur in the rectal wall, then obliteration of the vaginal lumen occurs. The final changes in the rectum are the same as in the bladder and the ultimate result may be a vesico-rectal fistula. The consequence is a severe infection of the bladder.

The differential diagnosis must consider an active carcinoma. Microscopic examination will render a positive diagnosis.

The treatment must be conservative. Obviously the avoidance of over-irradiation and repeated irradiation with a full dose are the only means to prevent such tertiary reactions.

Local irritation must be avoided. The administration of hyoscyamus, lithium benzoate, lithium citrate, or sodium citrate is beneficial. Lavages with boric acid solution tend to remove the gritty deposits and tissue débris. Hot baths may relieve the local distress.

If the trophic ulcer should break down, then surgical intervention is indicated, if the cancer has been completely arrested. Surgical repair or excision is not advisable. The process is, as a rule, a progressive one; the surgeon cannot decide from macroscopic examination whether or not he is working in normal tissue. Tissues damaged by irradiation heal poorly, if at all. The best possible relief is obtained by transplantation of the ureters into the sigmoid if the rectum is normal.

In a case of recto-vesical fistula following irradiation given in 1914 that came under our care a colostomy was performed. The urine receptacle now consists of bladder and rectum. The patient feels comfortable and is indeed grateful. The bladder has cleared up and the hemorrhages have ceased.

CONCLUSIONS

1. Complications in the urinary tract of women suffering from cervical carcinoma are frequent. They may result: (1) from an extension of the primary cancer; (2) from pelvic infections associated or complicated with the carcinoma, and (3) from the action of the rays, if the technique of application was faulty or if the tissues possessed a lessened resistance or idiosyncrasy to radiation.

2. The complications may be divided into: (1) primary, occurring at the time of treatment; (2) secondary, appearing within twenty-one to twenty-eight days after treatment, and (3) tertiary, developing some years after treatment.

3. The complications arising in the ureter and kidney have been discussed and methods for prophylaxis and treatment have been given.

4. The complications occurring in the bladder are frequent and are usually caused

by the primary cancer, though late irradiation complications are seen which very frequently result from untimely and faulty technique. The treatment has been discussed.

5. Routine examinations of the urinary tract before and after irradiation are recommended to avoid unnecessary complications in the urinary tract from radiation therapy for carcinoma of the uterine cervix.

6. It is evident that some patients possess a true idiosyncrasy to rays. It is probable that a great number of late complications may be explained on this basis if the technique of irradiation has been correct.*

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* For discussion see page 59.

RESULTS OBTAINED IN THE TREATMENT OF CARCINOMA OF THE CERVIX UTERI WITH RADIUM AND ROENTGEN RAYS FROM 1915 TO 1923, INCLUSIVE*

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DURING the period between 1915 and 1924 inclusive, 981 cases of carcinoma of the cervix uteri were treated with radium and roentgen rays at The Mayo Clinic. In this same period 136 cases of carcinoma of the uterine cervix were seen, but treatment was not applied. Operation had been performed or treatment by irradiation had been instituted elsewhere in 52 of these cases. In 129 cases operation or treatment by the Percy cautery was carried out at the Clinic.

In the early years, the diagnosis was made on the basis of history and general examination and, in selected cases, on operative data. In later years, these methods were substantiated by the removal of bits of tissue for microscopic study.

To facilitate the presentation of our material, a series of tables was prepared. The classification used in previous publications of similar cases has been adhered to and is based chiefly on the anatomic distribution of the disease at the time the case first was observed.

Four groups of cases were encountered: operable, borderline, inoperable, and modified. The age incidence is shown in Table 1 according to groups. The modified and inoperable groups include sufficient numbers to furnish a reliable estimate, showing clearly that the disease occurs most frequently during or near the age of the menopause. Although the borderline and operable groups are small, yet the average age is greater. Observation teaches us that the

TABLE I

AGE INCIDENCE

Age, years	Modified group		Inoperable group		Borderline group		Operable group	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
20–24			1	0.18				
25–29	12	2.79	8	1.48				
30–34	52	12.12	22	4.09				
35–39	59	13.75	57	10.61	1	7.69		
40–44	79	18.41	78	14.52	1	7.69		
45–49	71	16.55	98	18.24	2	15.38	1	50.00
50–54	72	16.78	96	17.87	3	23.07		
55–59	50	11.65	83	15.45	3	23.07	1	50.00
60–64	25	5.82	53	9.86	1	7.69		
65–69	7	1.62	30	5.58	1	7.69		
70–74	2	0.46	8	1.48	1	7.69		
75–79			3	0.55				
Total	429		537		13		2	
Average age, years	46.15±0.3		50.33±0.29		54.4±1.6		52.5±2.4	

* Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8–9, 1929.

TABLE II

SURVIVORS OF ALL GROUPS BY YEARS

Year treated	Total cases	Years of postoperative life of various number of patients*												
		1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1915	5	1	1	1	1	**1**	1	1	1	1	1	1	1	1
1916	63		23	14	10	7	**5**	5	5	5	5	5	5	5
1917	93			50	27	21	18	**17**	13	12	11	9	8	8
1918	135				62	40	26	20	**16**	15	10	8	6	6
1919	145					77	44	33	20	**18**	16	14	11	9
1920	151						84	58	42	38	**37**	31	28	27
1921	118							62	51	46	39	**39**	35	34
1922	136								71	52	39	30	**28**	25
1923	135									81	60	50	42	**41**

*The boldface figures indicate the numbers of patients living five years after treatment.

older patients do not have, as a rule, bulky or heavily infiltrating lesions; therefore, from an anatomic point of view great care must be exercised in grouping them. The extent of the primary neoplasm is best ascertained by inspection, with the patient in the knee-chest position; the chance for error in grouping is greater in older patients.

In Table II the survivors of all groups were classified according to the year in which treatment was given. The number of patients living five years after treatment was taken as the significant figure. In 1920 this figure rose sharply. The number of survivors after five years of those patients treated in 1920 is almost 100 per cent greater than the corresponding number of survivors among those who were treated in the three years preceding 1920. There are many contributing factors to be considered, however, of which greater individualization in treatment with radium is the most outstanding. A careful bimanual pelvic examination, and placing the radium applicators while the patient is in the knee-chest position, furnishes the best means of selecting those factors in treatment which are necessary to meet the needs of the patient under consideration.

Data concerning groups of the treated and traced patients giving the results following the third and fifth years after treatment were given and when possible following the seventh and tenth years (Table III). Returns or positive information concerning 898 patients, 91.53 per cent of the total of 981 patients, are recorded. The modified group shows that 122 patients (31.20 per cent) are living after three years, and that 95 patients (24.29 per cent) are living after five years, whereas the figures for the inoperable group are slightly lower; 138 patients (27.83 per cent) are alive at the end of the three year period, and 99 patients (20.04 per cent) are alive at the end of the five year period. Probably the most suggestive factor to be considered is that of the extent of the primary lesion. It seems reasonable to assume that the patients in the modified group, when first seen, did not have the extensive local involvement and the usual break in general health which is so common with patients in the inoperable group. In other words, the disease was arrested earlier in its development when the health of the patient was good. The number of patients in the operable and borderline groups is too small for comparison; however, it is evident that this group can expect much from efficient irradiation devoid of the risk usually assumed when surgical intervention is carried out.

TABLE III

CLASSIFICATION OF PATIENTS TREATED AND TRACED BY GROUPS

Group	Year	Total cases	Patients traced	Lived 3 years		Lived 5 years		Lived 7 years		Lived 10 years	
				Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Modified	1915	4	4	1	25.0	1	25.0	1	25.0	1	25.0
	1916	39	38	8	21.05	4	10.52	4	10.52	4	10.52
	1917	55	53	17	32.07	15	28.30	11	20.75	7	13.20
	1918	69	61	16	26.22	9	14.75	6	9.83	3	4.91
	1919	59	54	15	27.75	11	20.37	7	12.96		
	1920	60	53	21	39.62	19	35.84	15	28.30		
	1921	36	31	11	35.48	9	29.03	7	22.58		
	1922	59	54	16	29.62	13	24.07				
	1923	48	43	17	39.53	14	32.55				
	Total	429	391	122	31.20	95	24.29	51	13.04	15	3.83
Inoperable	1915	1	1								
	1916	24	24	2	8.33	1	4.16	1	4.16	1	4.16
	1917	38	34	4	11.76	2	5.88	1	2.94	1	2.94
	1918	65	59	10	16.94	7	11.86	4	6.77	3	5.08
	1919	85	84	18	21.42	7	8.33	7	8.33		
	1920	89	78	20	25.64	17	21.79	12	15.38		
	1921	74	66	30	45.45	25	37.85	22	33.33		
	1922	76	68	22	32.35	14	20.58				
	1923	85	80	32	40.0	26	32.50				
	Total	537	494	138	27.83	99	20.04	47	9.51	5	1.01
Borderline	1918	1	1								
	1919	1	1								
	1921	8	7	5	71.42	5	71.42	5	71.42		
	1922	1	1	1	100.0	1	100.0				
	1923	2	2	1	50.0	1	50.0				
	Total	13	12	7	58.33	7	58.33	5	41.66		
Operable	1920	2	1	1	100.0	1	100.0	1	100.0		
Grand Total		981	898	(91.53 per cent)							

The five-year cures are grouped under three divisions in Table IV according to the patients treated by irradiation and the patients traced following the treatment. When the totals of all groups encountered are added together there are 981 treated patients of whom 898 were traced. Two hundred and two are known to be alive five years or more after treatment; that is, 20.59 per cent of those who were treated, and 22.49 per cent of those who were traced. Some authors do not include the modified group in their reports. With this group omitted there is a total of 552 patients who were treated, of whom 508 were traced. One hundred and seven patients are known to be alive for five years or longer after treatment; that is, 19.38 per cent of those who were treated, and 21.06 per cent of those who were traced. Only 15 patients were treated in the operable and borderline groups combined, 13 of whom were traced. Of these, 8 patients are known to be alive for five years or

Table IV
FIVE-YEAR CURES BY GROUPS

Group	Treated by radium, cases	5-year cures	Per cent	Patients traced	5-year cures	Per cent
Operable, inoperable, borderline, and modified	981	202	20.59	898	202	22.49
Operable, inoperable, and borderline	552	107	19.38	508	107	21.06
Operable and borderline	15	8	53.33	13	8	61.53

longer after treatment; that is, 53.33 per cent of those who were treated, and 61.53 per cent of those who were traced.

The cases were studied according to the length of life by grading of the pathologic change (Table v) as reported by the pathologist from the observation made of the bit of tissue usually removed from the primary tumor at the time of the first application of radium. However, biopsy was not the practice with the earlier patients treated, as shown by the data furnished. Of the total of 981 patients, material for study was available in only 545 cases. Epithelioma was reported in 496 cases, 90 per cent of the cases in which report of biopsy was available. Adenocarcinoma was reported in 42 cases (7.70 per cent). In 7 cases (1.28 per cent) both epithelioma and adenocarcinoma were found in the material sent in for study. These figures furnish a total of 545 cases; of these, 501 were graded according to Broders' method of grading. The number of carcinomas graded 1 and 2 gave a total of 88 cases (17.56 per cent) on the basis of 501, whereas the number of tumors graded 3 and 4 gave a total of 413 (82.43 per cent). This shows rather clearly that the growths of high-grade malignancy predominate in the cases of carcinoma of the cervix uteri. The report made by the pathologist is of great value to the radiologist, especially in planning the initial as well as the future treatment of the patient. However, there is a great chance for much confusion in including such data in a study of this kind. Broders found that surgical operation would produce good results in epitheliomas graded 1 and 2, whereas in those graded 3 and 4 results from surgical operation were poor. This is not the experience of the therapeutic radiologist in the treatment of cases of carcinoma of the uterine cervix, as shown in Table vi. The patients who lived three and five years are grouped according to grade of pathologic change. The epitheliomatous lesions graded 3 and 4 are in sufficient numbers to justify the statement that slightly more than a third of the patients are alive at the end of the three-year period. The borderline group is small; however, similar lesions showed that 71.42 per cent of the patients with lesions graded 3 and 4 are alive at the end of the fifth year. The adenocarcinomas, also, are few in number; however, it can be safely stated that they do respond to irradiation and the results are equal to and may exceed those in epithelioma.

The hospital mortality rate is shown in Table vii. The risk occurs in the modified and inoperable groups and a careful analysis of the deaths shows that the danger was not in the effects of the treatment applied, but in the destructive processes of the malignant disease. If it had been possible to determine this state of affairs before the treatment was applied, it would have been grossly obvious that treatment by irradiation was contraindicated.

SUMMARY

This report deals primarily with the cases treated in the early years of the establishment of treatment by irradiation at The Mayo Clinic.

The immediate and late results are very gratifying when compared with the results obtained with the previous surgical methods. Further, the lack of the mortality and morbidity features attending opera-

TABLE V

CLASSIFICATION OF LENGTH OF LIFE BY GRADE OF PATHOLOGIC CHANGE

Group	Microscopic diagnosis	Total cases	Unable to trace	Died within 1 year	Died, time not stated	Length of life, years					
						3	5	6	7	9	10
Modified	Epithelioma, not graded	26	4	1	2	13	10	8	7	5	3
	Epithelioma, graded 2	29	3	5	3	9	8	6	5	4	4
	Epithelioma, graded 3	99	5	21	11	39	27	17	10	4	1
	Epithelioma, graded 4	65	4	21	9	17	13	9	9	3	3
	Adenocarcinoma, not graded	5	1	1		3	2	2	1	1	1
	Adenocarcinoma, graded 1	3				2	2	1	1		
	Adenocarcinoma, graded 2	11		1		5	5	4	3	1	
	Adenocarcinoma, graded 3	5				4	4	3	3	1	1
	Adenocarcinoma, graded 4	1				1	1	1			
	Adenocarcinoma and epithelioma, graded 2	1									
	Adenocarcinoma and epithelioma, graded 3	4		2		1	1				
	Total	249	17	52	25	94	73	51	39	19	13
	No biopsy	180	21	74	15	28	22	17	12	5	2
	Grand total	429	38	126	40	122	95	68	51	24	15
Inoperable	Epithelioma, not graded	11	1	4		1					
	Epithelioma, graded 2	32	4	10	1	10	6	4	3		
	Epithelioma, graded 3	147	11	39	18	49	40	30	18		
	Epithelioma, graded 4	79	5	24	6	27	20	11	8	2	1
	Adenocarcinoma, not graded	2	1			1	1	1	1	1	1
	Adenocarcinoma, graded 1	1		1							
	Adenocarcinoma, graded 2	10		1	2	6	4	3	2		
	Adenocarcinoma, graded 3	3		2							
	Adenocarcinoma, graded 4	1		1							
	Adenocarcinoma and epithelioma, graded 2	1				1	1				
	Adenocarcinoma and epithelioma, graded 3	1				1					
	Total	288	22	82	27	96	72	49	32	3	2
	No biopsy	249	21	86	25	42	27	19	17	9	3
	Grand total	537	43	168	52	138	99	68	49	12	5
Borderline	Epithelioma, graded 3	5				3	3	3	3		
	Epithelioma, graded 4	2				2	2	1			
	Total	7				5	5	4	3		
	No biopsy	6	1	1		2	2	2	2		
	Grand total	13	1	1		7	7	6	5		
Operable	Epithelioma, graded 3	1	1								
	No biopsy	1				1	1	1	1	1	
	Total	2	1			1	1	1	1	1	

TABLE VI

THREE-YEAR AND FIVE-YEAR CURES BY GRADE OF PATHOLOGIC CHANGE

Group	Microscopic diagnosis	Total cases	Patients traced	Lived 3 years	Per cent	Lived 5 years	Per cent
Modified	Epithelioma, graded 2	29	26	9	34.61	8	30.76
	Epithelioma, graded 3 and 4	164	155	56	36.12	40	25.8
	Adenocarcinoma, graded 1 and 2	14	14	7	50.0	7	50.0
	Adenocarcinoma, graded 3 and 4	6	6	5	83.33	5	83.33
Inoperable	Epithelioma, graded 2	32	28	10	35.71	6	21.42
	Epithelioma, graded 3 and 4	226	212	76	35.84	60	28.30
	Adenocarcinoma, graded 1 and 2	11	11	6	54.54	4	36.36
	Adenocarcinoma, graded 3 and 4	4	4				
Borderline	Epithelioma, graded 3 and 4	7	7	5	71.42	5	71.42

tions in this field makes the treatment all the more acceptable. It can be relatively safely stated that the patients in the modified group were beyond help by further surgical operation and that those in the inoperable group were too far advanced in disease for any type of operation. Yet irradiation has brought about much palliation in practically all cases treated and has saved one-third of the patients for a period of three years. Experience in this field of treatment warrants the statement that better results will be possible in the future and especially so if it is possible to see patients soon after the onset of the disease.

TABLE VII

HOSPITAL MORTALITY RATE

Group	Total cases	Hospital mortality	Per cent
Modified	429	5	1.16
Inoperable	537	6	1.11
Operable	2		
Borderline	13		

Probably the best means at our disposal is the education of women to report irregular vaginal discharge immediately, as well as education of the physician to appreciate the significance of these signs and to examine the patient and institute proper measures at once. The periodic general examination should do much to bring about this desirable feature in the management of cases of carcinoma of the uterine cervix.

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DISCUSSION ON PAPERS OF DRS. SCHMITZ, AND BOWING ET AL.

DR. ROLLIN H. STEVENS, Detroit, Mich. Dr. Schmitz and Dr. Bowing used the word "inoperable" in a way which I think is a little confusing, yet we all use it in the same way. What is an inoperable cancer? It is not only the fixed, frozen pelvis, but also Broders' grade 3 or 4 are exceedingly malignant cancers, and I think most authorities will agree that they too are inoperable. This would probably have some bearing on the discussion in regard to Dr. Bowing's modified cases.

Dr. Bowing stated that his excellent results were obtained because of a definite technique which he follows, namely knee-chest position,

etc. It is very probable that it is not the particular position in which the patient is placed during the application of radium but that the radium after being placed gives a very much better distribution of the radiation in vagina and to the parametrium which accounts for his most excellent results. I am not certain whether Dr. Bowing wishes to leave the impression that every case is treated for the same length of time with the same amount of radium. It seems to me that there would be other factors which would influence the results, such as the type of growth, the amount of infiltration, and the length of time that the radium is used, as well as the amount of radium.

In connection with the late lesions as pointed out in Dr. Schmitz' paper, some five or six years ago I remember Professor Forssell, in discussing a paper before one of the Scandinavian radiological societies, stated that he had seen only 2 or 3 cases of late necrosis develop after irradiation, and in those cases the patients were always syphilitic. I think we cannot consider these cases as all due to syphilis, but it is quite probable, according to the experience of many men, that infections play an important rôle in the production of the late radionecrosis. This would lead us to the importance of eradicating as much of the infection in the genitourinary tract as possible, as Professor Regaud tries to do, before beginning the radium treatment. The infection certainly lowers the resistance of the tissues. There may not necessarily be a lowered resistance to cancer and yet the infection in the tissue may be the traumatic insult that is responsible for the later development of cancer. If the tissue is already diseased, if the blood vessel walls are thickened and the connective tissue increased, it can be seen that treatment which increases this difficulty would later on lead to radionecrosis.

DR. R. E. LOUCKS, Detroit, Mich. Dr. Bowing's suggestion a few years ago about giving the treatment in the knee-chest position was timely for many of us. Since he first mentioned this, nearly all of my uterine cases have been treated in that way, especially if the rectal examination reveals anything suspicious, such as infiltration in the parametrium. It is convenient to treat in the knee-chest position; but I treat in the perineal position when there is a nodule involving the bladder wall. Unfortunately, all of these cases have a prolapsed bladder wall and there is rectocele and all sorts of things that we have to protect against with our packing.

DR. BOWING. I am sure that you agree that Dr. Schmitz' study deals with a very important feature of radiation therapy. In his opening statements he mentioned that urinary complications are on the increase in cases of carcinoma of the cervix uteri treated with irradiation. This does not tally with my own experience. I am sure that you are acquainted with the report of Dr. Stacy concerning complications occurring in similar cases treated on our service at the Mayo Clinic and I am pleased to report that by rearranging our treatment factors it has been grossly apparent to me that these distressing complications have been greatly reduced. The greatest number occurred during the early years and I am optimistic enough to think that they will not occur in the years to come. This feature of the treatment of carcinoma of the cervix has been very satisfactory since we have assumed the attitude that these lesions should be prevented and this in our hands has been brought about by reducing the number of hours of application, by applying more highly filtered radiation, and making certain that the distance factor employed will remain constant. This selection is best made when the patient is in the knee-chest position since the treatment field can be clearly visualized, which aids greatly in the selection of the proper treatment factors to best suit the case under consideration. I feel reasonably confident that a standard treatment time, and especially the twenty-four hour application, is most responsible for tissue changes described so well by Dr. Schmitz. I do not wish to be critical. However, I believe we should avoid the prolonged application in the treatment of carcinoma of the cervix. It is possible to obtain a satisfactory response through the divided dose method, by increasing the number of applications, and correspondingly reduce the treatment time as well as use highly filtered radiation.

DR. SCHMITZ (closing). We divide the carcinoma cases into four clinical groups, depending on the extent of the growth. Group I includes tumors not larger than 1 to 1.5 cm. In group II are placed the lesions that have involved at least one-half of the cervix. Group

III contains the advanced carcinomas and group IV the hopeless fixed carcinomas. Movability of the uterus is determined by hooking a tenaculum forceps to the cervix. If we cannot pull the cervix down to the outlet then we assume that the parametria are involved. Examination through the rectum corroborates this finding. The cases with limited mobility and parametrial involvement are placed in group III. In group II we place the carcinomas with complete fixation, or with involvement of the bladder or rectum, or both.

The reason we divide the cancers into four clinical groups is to determine the method of treatment and the relative prognosis of treatment. If the carcinoma has caused fixation it is usually hopeless. We have exceptions, but we have never seen a case of fixed carcinoma that benefited by any kind of treatment. The bleeding and offensive discharge may be arrested by a small dose of radium. Fixation may be due to infection within the pelvis which may subside following local treatment, then the proper clinical grouping and treatment may be determined. Cases in clinical groups I, II and III are treated with irradiation, though the group I carcinomas may be subjected to panhysterectomy.

It seems you have the impression that all of our cases are treated in the same way, i.e., with the same dosage. However, we individualize the treatment and the doses given are the average. I mentioned that in one case the patient had been cauterized. Thereby an unfavorable condition was brought about before the radium was applied. This was done in 1914 or 1915, when we were still not in agreement about the proper procedure of treatment. We consider the average dose to be about 3500 mg-hr. of radium in group I, II and III cases. In group IV the patient is treated palliatively with 1200 mg-el-hr. of radium. The 1200 mg-hr. we deem sufficient to arrest the bleeding and to render the field clean. If there is invasion of the bladder we use only the roentgen radiation. If regression of the bladder metastasis occurs, we then follow with radium applications to the cervix. These points are all considered in the paper.

Concerning applications of radium, the Bowing method of using twelve or fourteen hour seances repeated every third day may be a better method than the twenty-four hour applications at eight day intervals used by us. However, we find our method very satisfactory, and the good five-year end-results prove the conclusion.

The bladder and ureter complications seen in our clinic are the result of either an idiosyncrasy of the patient or a faulty technique. Most of these cases entered the hospital on account of these complications and after having been treated somewhere else. It seems to us that reapplications of radium after a proper course of radiation therapy have caused most of the urinary tract complications. We therefore deem it poor procedure to advise repetition of radium or roentgen applications. I recently saw a patient who was in a hopeless state from carcinoma. Three years ago she was treated with 3600 mg-hr. of radium, which was probably packed in the vaginal canal. Since then the patient has had four complete seances of short wave roentgen therapy, and in addition has had three massive radium applications. She now has fistulae of the bladder and rectum, besides a frozen pelvis and retention of urine in both kidneys. The reason this paper was written was to call attention to the matter and to discuss diagnosis and treatment of such complications.

Terms operability and inoperability I think are poorly chosen. When surgery was the sole treatment for carcinoma of the cervix surgeons would not hesitate to operate as long as the tumor could be removed. Depending on the skill possessed, operability was extended more and more. One saw patients operated upon with extensive infiltration of the parametria. The operative mortality and complications were high. Instead of determining operability by the individual technical skill of the surgeon, it is preferable to determine operability or inoperability by such factors as normal movability, impeded movability, fixation, paracervical infiltration, parametrial infiltration, regional lymph node involvement, and so forth. Standardization of clinical grouping will mean an advance in the treatment of cancer and divide the cases into those to be treated surgically, radiologically or palliatively. Statistics based on such grouping and comparison of results of the various methods of treatment will bring us nearer the ideal than the present antiquated methods based on operability or inoperability.

The good end-results Dr. Bowing has ob-obtained are wonderful. According to these results, arranged on the classification of Broders it appears that the clinical extent of the cancer does not influence the good end-results, but that the degree of histological malignancy or grading does. In our work in Chicago, we observed that carcinomata with a high degree of histological malignancy will show fewer five-year good end-results than those with a low-grade malignancy. If I remember correctly, Dr. Bowing reported the end-results last year on carcinoma of the rectum, and those with a low-grade malignancy showed a higher percentage of cures. Healy found that patients with a high degree of malignancy show better end-results than those with low malignancy. It would be well to restudy the entire question and determine the reason for these apparently varying reports.

DR. BOWING (closing). In reply to Dr. Stevens' question I am sure that we are all in agreement with the statement that there is a widespread misunderstanding concerning the method of classifying cases of carcinoma of the cervix uteri. Further, I am sure we will all agree that this feature is very important to a clear understanding when reporting cases. It seems clear to me that the classification should have a definite background based upon experience. It should be simple and thus readily understood by all. Probably the one most suited to our present-day needs would incorporate terms as employed in the field of surgery. The term, operable lesion, usually indicates that it is a small lesion, that it was seen early in the development of the disease, and that the pathology is confined to the primary site. Inoperable lesion usually indicates that the disease has advanced beyond the site of the primary field. In speaking of the borderline lesion we usually indicate that doubt exists as to the extent of the tumor in that it may have advanced beyond the primary site. The recurring group should comprise those cases which have been diagnosed as operable or borderline and in whom an adequate procedure was done to combat the disease. It has been my policy to have a fifth classification which has been termed the modified group. One will encounter a group of patients in whom one is reasonably certain that the condition was inoperable when first treated; and further, that a procedure was attempted which was apparently inadequate; however, the patient derived a certain amount of palliation from what was done, and in many patients, further cautious treatment may mean a return to health. So, with this in mind, these patients are deserving of our best consideration and should not be confused with any of the above groups. For the present it does not seem necessary that we hold to the classification which has been based upon a wide surgical experience. From the standpoint of prognosis I feel that our best results should come from the treatment of cases in the operable and borderline groups and that palliation may be expected in the treatment of the inoperable, recurring and modified groups. As I recall Dr. Schmitz' classification, he divides the inoperable group into those with a frozen pelvis and those without, the latter usually associated with much pain and a break in the general health. I question at this time the importance of making this distinction. From the radiological point of view, Dr. Schmitz' point is well taken; however, there is a chance of misunderstanding in trying to divide the inoperable group under two headings. This occurs to me as a purely radiological problem and probably should not enter into our classification.

Dr. Broders' classification based upon microscopic findings is important to both surgeon and radiologist and should not be confused with the above classification. The basis for his classification is many thousands of patients carefully studied by him so that he has been able to designate certain types of tumors that respond well to surgical intervention and certain types of tumors that give poor results regardless of how radical the surgery was; with this in mind, it may be confusing to some to know that Broders' groups 3 and 4 do respond readily to radiation therapy. Broders' method should be considered a distinct advance in the field of radiology. I am hoping that as time goes on more accurate information will be forthcoming from laboratories in order that more efficient treatment may be given. May I reiterate that our classification should be simple and based upon a definite background of experience known to us all.

Vol. XXIV, No. 1

CARCINOMA OF THE OVARY

REPORT OF THREE CASES TREATED BY DEEP ROENTGEN THERAPY

By A. W. JACOBS, M.D.
NEW YORK CITY

IN A recent study of 15 cases of carcinoma of the ovary during the ten year period from 1914 to 1923 inclusive at the Montefiore Hospital, it was noted that the average total duration of life to 1921 inclusive, with no special therapy, was twelve months; while the average duration in 1922 to 1923, when deep roentgen therapy was instituted, was twenty-three months. From this it seems that roentgen therapy is a measure to be considered in palliation of symptoms and prolongation of life.

Three cases are here reported of ovarian carcinoma which were treated by deep roentgen therapy, with palliation of symptoms, prolongation of life, and up to the time of writing were in apparent comfort and symptomless. The factors used in the therapy were 180 kv., 4 ma., 50 cm. distance, 0.5 mm. Cu and 1.0 mm. Al as filter, twenty minutes each treatment (approximately one-third erythema dose).

CASE REPORTS

CASE 1. Mrs. S. Q., Jewess, aged forty-eight, was referred to me on April 10, 1929, with the following history: Married twenty-seven years, 2 children living, twenty-five and twenty-one years of age; two miscarriages twenty-six and twenty-four years ago. Menstruation started at seventeen, regular, but has been irregular for the past three years. Last period three weeks ago, painful and of nine days' duration. Had a curettage eighteen months ago for metrorrhagia. Onset of present illness was about six months ago, with cramps and sense of pressure in abdomen. Constipated, had to take cathartics. These symptoms have become more marked in the past four weeks. Has had menorrhagia for four months, periods which had been eight or nine days' duration prolonged to ten or twelve days, and increasing dysmenorrhea.

At operation by Dr. A. J. Beller at the Hospital for Joint Diseases, on March 20, 1929, were found hard, carcinomatous masses throughout entire abdomen, involving ovaries, entire pelvis, omentum, peritoneal surfaces and liver. A piece of omentum was removed for examination and pathological report was metastatic papillary adenocarcinoma, probably primary in the ovary. Nothing to be done surgically, abdomen was closed.

On April 10, 1929, physical examination showed a well-nourished adult female, moderately dyspneic and cyanotic, complaining of a sense of pressure in abdomen, and hiccough. The positive findings were marked prominence of the abdomen and signs of fluid within the abdomen, on account of which no masses were palpable. Immediate paracentesis abdominalis was advised, to be followed by deep roentgen therapy. On April 16, 1929, 4500 c.c. of fluid was removed, 5000 c.c. on May 1, and 4500 c.c. on May 6. There was no doubt that fluid was re-accumulating rapidly. On April 29, 1929, patient was examined by Dr. William P. Healy, who concurred in the diagnosis and agreed with the therapeutic plan of procedure. Between April 10, 1929, and May 8, 1929, twelve treatments were given to the pelvis anterior, posterior, left and right lateral fields, 20×20 cm. 180 kv., 4 ma., filter 0.5 mm. Cu +1 mm. Al, twenty minutes each at intervals of two or three days.

On May 16, 1929, she was referred to the New York City Cancer Institute for further observation, then complaining of pain and swelling in the abdomen and legs and general weakness, of two months' duration. She was admitted to the hospital of the Institute on Welfare Island, orthopneic and complaining of hiccough. Physical examination revealed flatness and absent breath sounds over left base of chest and abdomen distended with signs of fluid present. On May 18, 1929, about 900 c.c. of clear fluid was removed by thoracentesis, and on May 19, 2500 c.c. was removed by paracentesis. Blood examination on May 22, showed red blood cells, 3,800,000; Hgb, 70 per cent; white blood cells, 6000, and negative Wassermann reaction.

Examination by Dr. I. Levin, director of the Cancer Institute, revealed a hard irregular mass to the left of the umbilicus, and another above the symphysis pubis and resistance in both sides with a mass posteriorly on rectal and vaginal examinations. In his opinion, the masses were too large to be influenced by radiotherapy, the case was beyond specific therapy, and needed custodial care.

Examination about five weeks later, July 3, 1929, by Dr. I. Levin showed the abdomen to be soft, small masses palpable in the right pelvic region, also palpable on vaginal examination, and uterus enlarged. Deep roentgen therapy to the pelvis, twenty minutes, once a week was advised.

Examination on October 17, 1929, revealed abdomen to be soft, no masses palpable by abdominal or vaginal examination with no evidence of fluid present.

The second series of eight treatments, which were given in the clinic, extended over the period of ten weeks between September 5, 1929 and November 21, 1929.

On December 9, 1929, which was four months after the patient was discharged from the hospital, examination showed her to be gaining in weight, appetite good, bowels regular, and absolutely symptomless. Has had no menstrual period for seven months. Physical examination showed no masses in the abdomen and no evidence of ascites.

CASE II. N. G., Jewess, single, aged twenty-eight, was referred to me on May 19, 1928, with the following history: Had measles and pertussis in childhood, influenza in 1918. Menstruation started at the age of fourteen, regular every twenty-eight days, normal, last period April 21, 1928. Operated upon in November, 1926, at Union Hospital for abdominal tumor. Since then felt fine until four months ago, when she had a painful menstrual period and upon examination of the abdomen another tumor was found. At operation April 19, 1928, at Mt. Sinai Hospital by Dr. A. J. Beller, a neoplasm of the ovary was removed, pathological report of which was adenocarcinoma. General condition of the patient was good. Deep roentgen therapy to the pelvis was instituted on May 19, 1928, anterior, posterior and lateral fields, thirty minutes each, with a total of eight treatments to June 20, 1928. Another series was given from October 8, to November 8, 1928, twenty minutes each, and a third series between March 14, 1929, and April 11, 1929, twenty minutes each treatment. General condition of the patient during this time was good, with no symptoms or evidence of recurrence. The patient was advised to return in three months for observation of her condition but in spite of written notification failed to do so until December 2, 1929, when she returned complaining of a marked swelling over lower sternum, which had existed for six months, was increasing in size, painful and tender. General condition at this time showed some emaciation, loss in weight and anorexia. Local examination showed a hard mass arising from the lower anterior aspect of the sternum, hard in consistency and tender, apparently metastatic. Deep roentgen therapy was immediately instituted to this region, on December 2, 1929, treatments given daily, with diminution in size about one week after therapy was commenced so that examination on January 28, 1930, showed entire disappearance of the mass and general condition improved. She had gained 8 pounds in weight, and had returned to work.

CASE III. H. M., married, aged thirty-nine, was operated upon in 1919 and 1925 at St. Luke's Hospital, pathological report adenocarcinoma of the ovary, had received postoperative radiation therapy at intervals. Has had no menstrual period since operation in 1919. Under my observation since January 16, 1929, has received three series of deep roentgen therapy up to December 30, 1929. She is at present symptomless and at work in her office, though a hard mass is still palpable on abdominal examination.

Comment. The first case reported in this group is of unusual interest inasmuch as the malignancy was generalized throughout the abdomen with rapid re-accumulation of ascites, and in spite of the little benefit to be expected by radiation therapy, the improvement has been remarkable. The second case reported shows what can apparently be accomplished by attempts at therapy in a metastatic condition from primary carcinoma of the ovary. The third case reported shows apparent arrest of the neoplastic process by irradiation.

CONCLUSION

It is a known fact that such results as obtained by radiation therapy in the cases reported do not and will not invariably occur in all carcinomata of the ovary. However, it is our duty to give each case a fair trial where surgical measures can accomplish nothing. It would probably be of considerable aid in prognosis if it were made a practice to have pathological specimens removed for diagnosis, classified by a competent, experienced pathologist who can report on the degree of radiosensitivity of the neoplasm. Carcinomata of the ovary apparently are of different grades and types and should be classified by the pathologist as are those of the cervix uteri.

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EDITORIALS

THE RADIOLOGISTS' LIABILITY INSURANCE

IN DELVING into the liability insurance situation it has been most interesting to find that the three companies which carry the major portion of insurance for the members of The American Roentgen Ray Society are concerned as much as we are and perhaps more, for the Society's Committee on Laws and Public Policy received from them every courtesy and cooperation. Two of them placed the records of their entire experience at the Committee's disposal, and were quite frank in revealing all pertinent information. Much interest in the subject has also been manifested by the members of the Society as evidenced by responses to the questionnaire sent out. A careful survey and compilation of the data obtained from these questionnaires and from repeated conferences with officials of the companies writing this type of insurance has revealed some very instructive facts.

Prior to a few years ago radiologists obtained insurance at the same rates as medical and surgical practitioners, but the insurance companies discovered that the risk involved was so great, especially in radiation therapy, that a marked increase in the rates was made. They are frank in admitting that it is very difficult for them to calculate the results, but they feel that they have carried this variety of insurance at a loss since 1913. In fact, the experience of the companies had been so discouraging that they considered discontinuing coverage for roentgen therapists. However, it is encouraging to find that in the last five years their experience with the members of this Society has improved greatly, and that their loss through men who limit their work to radiology is showing a marked diminution. It is surprising to learn that a large number of suits filed or threatened are for injuries incurred in diagnostic work which are not roentgen-ray reactions but electrical shocks or burns sustained by patients or their friends coming in contact with wires or tubes during exposures.

At present, radiologists engaged solely in diagnosis are insured at the same rate as general practitioners, but an additional premium is charged if roentgen or radium therapy is employed. This rate is based on the experience of the insurance companies in the locality in which the insured is practising. For example, the basic rate in New York State for general practitioners and roentgen diagnosticians is $32.00 per year on a $5000 to $15,000 coverage, but an additional premium must be paid if roentgen or radium therapy is employed. There is an apparent lack of standardization of charges by the various companies, for discrepancies are shown in the answers to the questionnaire. As an illustration, two men in the same locality, doing the same character of work, carried the same insurance, yet paid widely different rates. In one instance of this sort both men were insured by the same company. Such inequality seems indefensible, but a variance in rates among states and localities finds justification in the differing laws of the several states, in local public opinion affecting courts and juries, and in the varying ethical morale and solidarity of physicians in different communities. Yet these are only minor phases of the problem and its essence is the general level of rates, which, in the opinion of two-thirds of the radiologists who answered the questionnaire, are too high.

In attacking this question it should frank-

ly be realized at the onset that, in the long run, rates must be adequate to cover losses plus a fair charge for administering the insurance fund. Hence the indispensable basis for a permanent reduction of rates is a reduction of liability losses, and to this latter end the radiologic profession can contribute effectively.

Electrical injuries, which are so provocative of lawsuits, can be diminished by frequent inspection, overhauling and rearrangement of apparatus or the installation of new equipment, by selecting more trustworthy technicians and imbuing them with the necessity of eternal vigilance and caution, and by active personal supervision of the work.

A potent deterrent to a threatened suit for damage is a well-kept case record, showing the date of examination or treatment, dates of previous examination or treatment elsewhere, diagnosis, details of treatment, warning to the patient regarding the application of irritants to irradiated areas, and every fact that may have any relation to subsequent reactions. A complete record may prevent litigation, or, if suit is brought may enable the radiologist to make an effective defense.

Every radiologist should willingly give testimony in malpractice suits brought against his fellows and ask to be reimbursed only for his actual expense, if he makes any charge at all. Fees of expert witnesses for the defense are charged eventually against the policy holders.

No upstanding radiologist will openly condemn the work of his fellows. He realizes that he is not acquainted with all the circumstances attending an accident or untoward reaction sustained by the patient of another physician. He knows that every stone he casts at his coworkers makes a dent in his own armor. But he sometimes fails to remember that brows lifted in surprise, faint praise, or an equivocal silence may betray a colleague and subject him to legal harassment.

Radiologists can avert damaging criticism by more intensive education of the general medical profession as to the rôle of infections, irritants and idiosyncrasies in producing reactions after irradiation, and as to the inevitable hazards of effective treatment in desperate cases of malignant disease. Members of radiologic organizations who appear on the programs of state medical societies have an excellent opportunity for service in this direction, and those who give talks over the radio can give the public much needed instruction.

Finally, in those states in which the laws are unfair and penalize the radiologist for the conscientious performance of his duty, the radiologic organizations should appeal to the legislatures for just and equitable enactments.

If by these means or others we can put our own house in satisfactory order I am confident that the insurance companies will adjust all minor inequities and give us protection at fair costs.

B. R. Kirklin

CARL S. OAKMAN

1876–1930

On June 19, 1930, occurred the death of Dr. Carl S. Oakman at the University Hospital, Ann Arbor, Michigan. For the past four years Dr. Oakman practised roentgenology in Muncie, Indiana. Dr. Oakman was a talented violinist, having at one time been a member of the Boston Symphony Orchestra. He was secretary-treasurer of the Digestive Ferments Co., Detroit, for thirteen years, and for three years was president and general manager of the Wilson Laboratories, Chicago. In 1924 he went to the University of Michigan as a member of the University Hospital Staff in the Department of Roentgenology, and in 1926 to Muncie. He is survived by his widow, one son, and two daughters.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-first annual meeting: West Baden Springs Hotel, West Baden, Indiana, Sept. 23–26, 1930.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles. Calif.
Annual Meeting, 1931, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting, 1931, to be announced.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.
Sixteenth annual session: Los Angeles, Calif., Dec. 1–5, 1930.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Robert A. Arens, Michael Reese Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, Fisher Building,
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary. Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L, G. Rigler, University Hospital, Minneapolis, Minn.
Next meeting Duluth, Minn., July 14, 1930.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston. Mass,
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr Robert E. Pound, Fifth Avenue Hospital.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Missouri Building
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY
Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.
Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Next meeting, Norfolk, Va., 1 P.M., Wednesday, Oct. 22, 1930.

CUBA

SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA
Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GE SELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖENTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw. Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. O. Wissing, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

THIRD INTERNATIONAL CONGRESS OF RADIOLOGY

In the May, 1930, number of the Journal there appeared a notice in reference to the Third International Congress of Radiology which is to be held in Paris, July 27 to 31, 1931. Additional information has just been received which will be of interest to radiologists.

The registration fee is 300 francs for each individual member, and 50 francs additional for each member of the family attending the Congress. Application blanks will be available at a later date.

The five United States delegates are: James T. Case, Chicago, Edwin C. Ernst, St. Louis, Mo., P. M. Hickey, Ann Arbor, Mich., Albert Soiland, Los Angeles, Calif., and Douglas Quick, New York City.

If anyone desires more detailed information regarding the Congress, it may be obtained from either the local Secretary, Dr. R. Ledoux-Lebard, Paris, or the Chairman of the U. S. delegates, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.

THE PROGRESS OF SURVEY OF RADIOLOGY

By the American Medical Association

The questionnaire which was prepared by leaders in radiology was sent out to a mailing list of 1,654 persons representing that specialty. A total of 1,150 questionnaires have been filled out and returned.

The Council on Medical Education and Hospitals, which was asked to do this work, is now tabulating the returns, after which it will publish its report, and will also prepare a tentative list of directors of approved radiological laboratories. The "Essentials," which have been prepared by representative leaders in the field, have accompanied each questionnaire sent out.

All who have not sent in the questionnaire should do so. Additional blanks will be furnished by the Council on Medical Education and Hospitals of the American Medical Association, 535 North Dearborn Street, Chicago.

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

THE CONSTRUCTION AND CALIBRATION OF A STANDARD DOSIMETER*

By ROBERT B. TAFT, B.S., M.D.
Charleston, South Carolina

I. CONSTRUCTION

FOLLOWING the First International Congress of Radiology, I came to the conclusion that while the Roentgen unit was probably not the final word in intensity measurement, it was undoubtedly the most satisfactory one; and that the electroscope-iontoquantimeter was the most practical instrument for its measurement. However, attention is called to the fact that an instrument of this kind measures the intensity of radiation and *not* the dosage of radiation. The dosage of radiation depends not only on intensity but on wave length and other factors which are beyond the scope of this paper. Therefore, no attempt is made in this communication to correlate the Roentgen unit and the biological effect.

A survey of commercial instruments showed that while all of them had their good points, each one had some defect. Therefore, I decided to build an instrument which would be rugged and precise, which would have incorporated in it many original features, and which would be free of the defects found in others. The instrument as finally completed, after many experiments and many failures, is shown photographically in Figure 1 and diagrammatically in Figure 9.

All the materials for the construction can be bought from supply houses in this country and the total cost is not over $25.00. All the machine work can be done in a small machine shop equipped with lathe and drill press such as is found in most large hospitals. The work can be done by any reasonably skilled mechanic who is familiar with electrical work. The calculations are well within the reach of a physican who has a working knowledge of simple algebra.

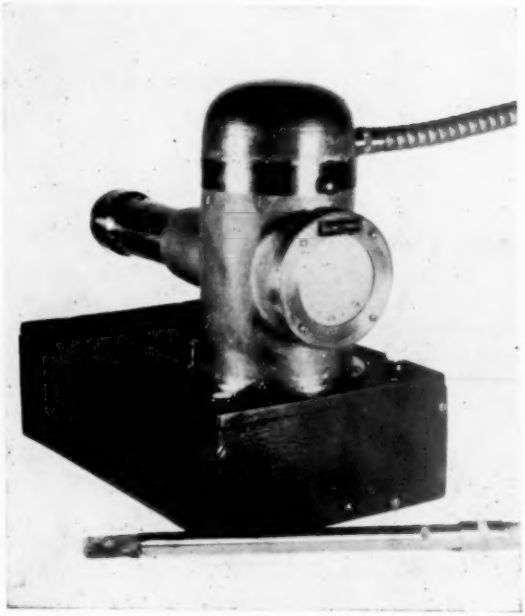

Fig. 1. The completed dosimeter, built according to the description given in the paper.

On first consideration, it might seem that the main housing for the instrument would present much difficulty, but it can be purchased from any plumbing supply house at small cost. It is known to plumbers as a "four inch drum trap," is made of lead about 5/64 inch in thickness and has a cast brass cap which screws on one end.

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

Figure 2 shows the trap as purchased. A wood rod is put inside it to give supporting strength and it is placed between centers of a lathe, a dog is clamped around the square end of the brass cap and a thin cutting-off tool is used to cut off a lead cap. The cut is made about one-fourth the way along the side from the curved end. This lead cap is put away to be used later for the cover of the instrument.

The next move is to cut two holes through the sides, diametrically opposite to each other, into which are to be inserted the frosted glass window on which the shadow of the gold leaf is cast, and the tail-tube which holds the small bulb which furnishes the light. One hole is 2 in. and the other 2-3/4 in. in diameter and their centers are 3 in. from the end that holds the brass cap. The simplest way to cut these holes is to turn out a wooden form which fits snugly in the lead pipe and use a small chisel. Figure 3 shows the appearance after the above has been done.

The next step is to make the lead forms which fit over the holes. As these need circular ends, they are moulded and the outside machined off with the lathe. This is accomplished as follows: An ordinary tin can of the same outside diameter as the lead housing is procured, covered with one thickness of paper and embedded in sand lying on its side. A mound of sand is built up on the can and a surrounding ring of sand furnishes the support for the outer portion of the melted lead. The lead is poured in and when cool it gives a rough casting, one end of which will fit perfectly up against the curvature of the lead housing. The casting is then mounted on the lathe and the outside finished off. Two castings are made, one somewhat smaller than the other as shown in Figure 1. No exact dimensions are given as simple castings of this kind made in this manner are rather crude, but they can be machined down to perfection. By referring to the illustrations, the mechanic can get the approximate size, as exact sizes are of no importance in this part of the construction.

Fig. 2. The "four inch drum trap" as purchased from a plumbing supply house.

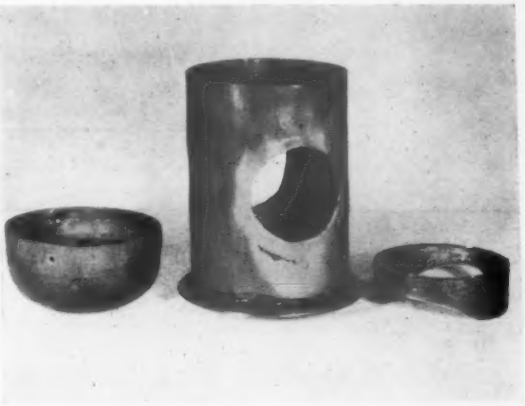

Fig. 3. The housing with cap cut off and holes cut in the sides. The finished casting for the ground glass is seen on the right.

The tail-tube is next arranged. This is a piece of ordinary 1-1/2 in. brass pipe, 5 in. long and threaded on one end. The end without the thread is inserted into the smaller lead casting which has been machined out to fit snugly.

The outer side of the larger casting is machined with a groove in the face, which accommodates the lead glass and the ground glass on which the scale is marked.

At this time the housing is ready for putting together. The castings are arranged over the holes and soldered in place with

half-and-half solder, using commercial paste as a flux. As lead is the easiest material to solder it is a simple task to do a very neat job. After the soldering is finished, all the rough edges are smoothed with a rat-tail file and later rubbed with steel wool. In a similar way, the brass pipe is soldered into the tail casting.

Next the brass cap that screws on the bottom of the housing should be heated on a stove and a thin layer of lead poured over the inside to furnish protection against stray rays. The cap is then screwed in place and soldered to the housing.

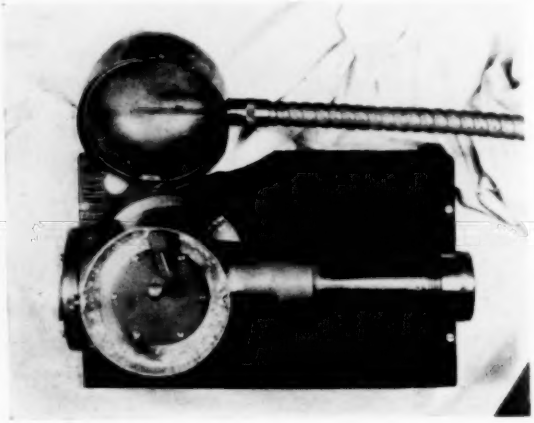

Fig. 4. A top view of the complete instrument with cap removed and turned upside down. The brass shelf is seen soldered into the housing and the leaf support is shown. Note the charging point which can be rotated to vary the distance from the ball.

Following this, a shelf is soldered in the upper part of the housing to support the mounting for the electroscope proper. This is shown in Figure 4, and is made of sheet brass 1/8 in. thick, cut into a circle fitting snugly in the upper housing and has a hole 2 in. in diameter cut in the middle. This is soldered in at a distance of 1-1/8 in. from the top as shown in Figure 4.

Then a small dehydration chamber to contain calcium chloride is arranged under the tail-tube as shown in Figure 5. A hole is drilled of such a size that a short nipple of a 3/8 in. brass pipe will fit snugly into it and the nipple is soldered in place. The chamber is made of a 3/8 in. brass coupling into the lower end of which a brass plug is screwed. Then a hole is drilled through the lower part of the coupling and plug, so that a rod can be slipped in to tighten it to the main housing. The coupling should be knurled for appearance and to give a grip for the fingers when it is taken off or put on. Make sure that the plug in the coupling is air tight, and if necessary coat the inside with solder.

Next a piece of 1/2 in. brass tube with thin wall is inserted through the shelf and through the brass cap on the lower end of the housing and soldered in place as shown in Figure 4. This is used as a conduit to bring the charging current up to the leaf.

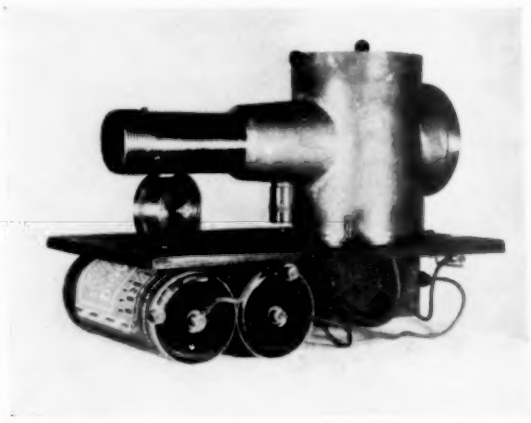

Fig. 5. The wooden base has been removed to show the batteries and spark coil. The cap on the end of the tail-tube is removed and turned around to show the light as well as the brush and brass ring which supplies the contact. Note the dehydration chamber under the tail-casting.

The main housing is now ready for finishing. It should be rubbed to a high polish with steel wool, both the lead and the brass parts. The brass parts should be covered with a thin coat of clear lacquer. The lead should not be lacquered as it will corrode. The entire inside of the apparatus should be painted flat black.

The glasses are next put in place. Three are needed, one disc of ordinary glass in the tail-tube, one of lead glass, for the front window and another of frosted glass upon which the scale is drawn. The lead glass and the ordinary glass are cemented in with

celluloid glue and the frosted glass is held in by the brass cap screwed on the front end as shown in Figure 1.

The lamp, which is used to cast the shadow of the leaf on the ground glass scale, is a 3 volt fine focus flashlight globe. The brass capas seen in Figure 5 is a 1-1/2in.pipe cap which has been dressed off and knurled. In the center of this is mounted a small porcelain wall socket, miniature size. One binding post of it is connected to the brass cap, the other is connected to a brass ring, mounted on top of a bakelite ring, serving to make contact with the brush mechanism as seen in Figure 5. The brush is bolted through a fiber ring inside the tail-tube. The wire is brought to the brush through a 1/8 in. copper tube which runs through the tail-tube and down through the bottom of the instrument. The wire itself is a piece of No. 20 BS double cotton covered shellacked.

The wooden box on which the instrument is mounted is made of some kind of well-seasoned hardwood 3/8 in. thick. The inside dimensions are $11'' \times 6\text{-}5/8'' \times 3''$. It is finished in dull black, and put together with brass screws with polished heads. Holes are bored in the cover of the box to line up with the holes in the bottom of the instrument through which the wires pass to the charging point and the lamp. The instrument is bolted to the box. A binding post is fastened to the housing at some convenient point to be used for ground connection.

The charging device has already been described in detail [5-7], and two standard dry cells are used to furnish power for the charging coil and lamp. A small switch is mounted on one corner of the base to act as a lamp turnoff, and a push button is placed on the other corner connected in the primary circuit of the spark coil. The lamp switch also acts as a main switch and prevents the possibility of charging when the lamp is not lighted. The method of mounting the needle point is shown in Figure 4.

The lead cap which was cut off the top of the drum trap is now worked on. As can be seen in Figure 1, a brass petticoat is soldered on the outside and slots are provided for fastening it to the housing with thumbscrews. A lead petticoat is also placed in the inside as shown in Figure 4. A hole is drilled in one side to accommodate the cable terminal and a brass escutcheon soldered around it. Note that the cap fits on the housing in such a way that the cable may be arranged either to the right or left of the operator to suit the convenience of his particular layout of apparatus.

The housing now being complete, the mount for the leaf is arranged. A disc of 3/16 in. hard rubber is cut and six holes drilled near the outer edge to bolt it to the shelf as shown in Figure 4. Corresponding holes are drilled in the shelf and threaded for a fine screw. Then a 3/8 in. hole is drilled about 3/8 in. from the center of the hard rubber disc. The actual leaf support is made as shown in Figure 6, an amber bushing being pressed into the 3/8 in. hole and fastened with celluloid cement. It is to

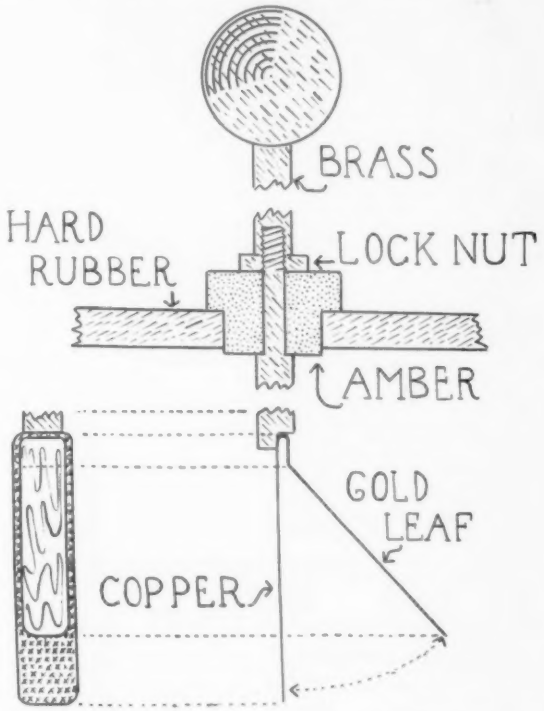

Fig. 6. Detailed drawing of the leaf and its mounting.

be noted that the leaf is mounted so that, when charged, it extends in the opposite direction from the conduit which brings up the high-tension wire. That is, if the conduit is on the left of the instrument, the leaf should swing to the right.

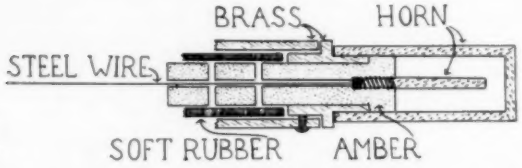

FIG. 7. Drawing of the ionization chamber and its attachment to the cable. Note that the steel wire has a small head soldered on it. The horn rod screws into the amber without any bushing and makes contact with the head on the wire.

Pure amber rods of 12 mm. diameter can be purchased from importing houses, but one must make very sure that the material is amber and not celluloid or bakelite as these two are absolutely worthless for insulation of this kind.

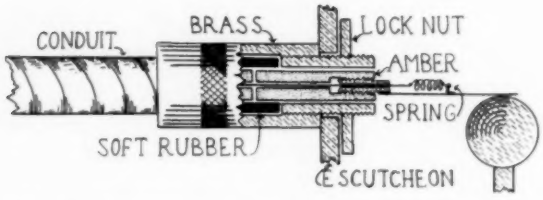

FIG. 8. Drawing of the end of the cable which enters the lead cap on top of the main housing. Note the coil spring which allows a slight motion of the steel wire when the cable is bent. The spring strip presses lightly on the ball on the head of the leaf support.

The leaf is made of gold and can be obtained from any sign-painting establishment. Aluminum leaf may also be used but I have had no experience with it. The leaf is 1/4″ × 1-1/4″, but the exact size is of no moment. This is cut by placing it between two sheets of paper, and cutting paper and leaf with a very sharp pair of scissors (preferably new ones). Any kind of glue is used for fastening the leaf to the mount. Numerous trials will be necessary before a perfect leaf is put in place, but when it is finally placed, it will last for years. Details of the leaf mount are shown in the drawing (Fig. 6).

After the leaf is mounted some calcium chloride is put in the dehydration chamber and allowed to stay for several days. In dry, cold weather, the leaf should hold its charge for several hours, and if it does not, either the amber is of poor grade, or has some foreign material on the surface, such as perspiration from handling.

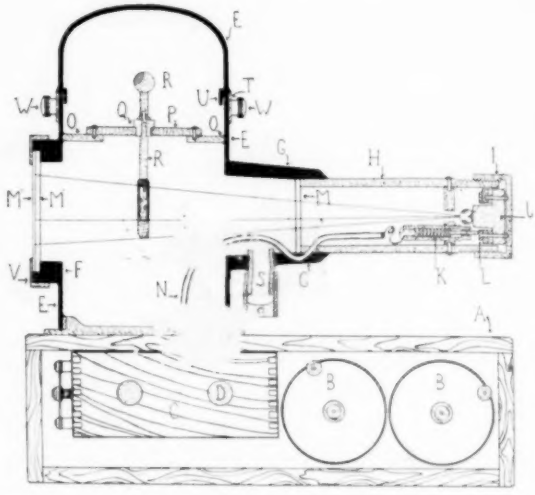

FIG. 9. A. Hardwood box. B. Standard dry cells. C. Ford spark coil. D. Positive high tension terminal. E. Lead casing. F. Casting for front window. G. Casting for tail-tube. H. Brass tail-tube. I. Brass cap. J. Porcelain socket. K. Brush mechanism. L. Commutator. M. Plain glass. M′. Lead glass. M″. Frosted glass. N. Copper tube carrying wire to lamp. O. Brass shelf. P. Hard rubber disc. Q. Amber bushing. R. Leaf mount. S. Dehydration chamber. T. Brass petticoat. U. Lead petticoat. V. Brass rim for window. W. Thumbscrews for holding cap.

After a satisfactory leaf is put in place and the charge remains for a satisfactory time, a small ink dot is put on the glass in the tail-tube and its shadow marked on the ground glass, so that when the bulb has to be replaced, the knurled cap on the tail-tube can be rotated until the marks again line up. In this way the error of parallax is avoided.

The attention is now turned to the ionization chamber and cable. (See Fig. 7.)

The chamber is turned out on the lathe from a piece of well-dried horn of a long-horned steer. About 2 in. from the tip is a portion that has no central cavity. The exact size is of no importance but the volume should be about 2 c.c. If the inner end is squared off, the measurement of the volume can later be made with greater accuracy. The rod inside the chamber is also of horn. The rod and inside of chamber are coated with India ink.

The cable is made of flexible conduit about 1/2 in. inside diameter and can be obtained from any electrical supply house. The inside should be carefully cleaned out by pulling pieces of cloth on a wire through the lumen. The terminals are couplings of 3/8 in. brass pipe with the threads bored out on one end, polished and knurled. The conduit is soldered into the end of the terminal from which the threads have been cut. Then a section of 3/8 in. brass pipe, 9 in. long with one end threaded, is screwed into the open end of one of the couplings. A piece of thick-walled soft rubber tubing is pulled through the conduit and the ends cut off even, all of the talcum having been carefully removed from inside and outside the tube. It is this rubber tube that absolutely prevents any ionization in the cable when stray radiation strikes it.

Next the process of making the amber beads that fill the tube is commenced. They are made of amber rod, 8 mm. diameter, cut into sections about 10 mm. long. It is unnecessary to round the ends. These sections are set up, one by one, in a scroll chuck of the lathe and a 1/16 in. hole drilled through the center of each. Length of the cable is made to suit the lay-out of the user but a cable 5 ft. in length is usually adequate. The conducting wire is a piece of fine steel piano wire. This is run through the beads and the entire string pulled through the rubber tube in the cable. The assembling should be done in cold, dry weather.

The details of the two terminals for the conduit are given in Figures 7 and 8. The bushings are made of amber rods 12 mm in diameter. Attention is called to the spring on the end of the steel wire which takes up the slack (Fig. 8).

A phosphor-bronze spring strip makes contact with the ball on the head of the leaf support. After the construction, the entire system is tested for leak. In dry weather the leaf should take several days to fall over the scale if there is no radiation in the region of the instrument.

In all the structural details, no effort has been made to give exact dimensions or directions as each builder will make some modifications in accordance with the materials on hand.

CONCLUSIONS

A dosimeter is described which has the following features:

Ruggedness. This instrument was carried in an automobile over rough streets without injury to the leaf.

The leak is negligible ranging from five days in dry weather to two days in very humid weather. There is no electrical saturation effect in the cable, that is, the leaf is just as stable the instant after it is charged as it is several days later.

Protection. The soft rubber tube in the cable prevents all ionization in it. The most powerful ray can be directed on it and there is no fall of the gold leaf except when the ionization chamber is irradiated. The main housing is of lead which prevents the entrance of any stray radiation.

Upkeep. This instrument has been in steady use for over two years and there has been no replacement of the leaf, one replacement of light, and two replacements of batteries. A radium check was made on November 13, 1926, with 50 mg. element and a careful drawing made of the position of the capsule on the chamber. The average time of the fall of the gold leaf for five trials was 193 seconds. Repeated December 21, 1928, the fall was 194.9 seconds. As it is impossible to reproduce the exact placing of the radium, this indicates excellent stability.

II. CALIBRATION

In the following explanation, I shall describe methods of calibration based entirely on electrical and mechanical factors of the instrument.

For the sake of completeness the definition of the unit used is quoted from the report of the Second International Congress of Radiology: "That this International Unit be the quantity of X-radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber avoided, produces in one cubic centimeter of atmospheric air at 0 degrees C. and 76 cm. mercury pressure, such a degree of conductivity that one electrostatic unit of charge is measured at saturation current." "That the International Unit of X-radiation be called 'The Roentgen' and that it shall be designated by the small letter 'r'."[4]

The author wishes to call attention to the fact that the units of measurement of potential and capacity are the "absolute units" of the Centimeter-Gram-Second system and *not* the volt and the microfarad. Failure to take note of this has led to many misunderstandings. The relationship is given as follows:

Electrostatic potential to volts, multiply by 300.[1]

The centimeter of capacity (C-G-S unit) is 1.1124 micromicrofarads.[3]

This formula is generally accepted as the proper relationship of the factors:[2]

$$\text{The number of Roentgen units transmitted} = \frac{C\,(V_1 - V_2)}{300v}$$

Where

C = capacity of system in centimeters.
V_1 = voltage of system at start.
V_2 = voltage of system at finish.
v = volume of chamber in c.c.

It therefore becomes a problem of determining the factors of this particular instrument and supplying them in the above formula to determine the number of r-units which the roentgen machine applies to the ionization chamber while the leaf falls over the predetermined part of the scale.

The first consideration is the volume of the ionization chamber whose walls are made of horn, having a low atomic weight. The easiest and most accurate way is to make a roentgenogram of the chamber on a dental film, with the tube at a long distance and exactly centered over the center of the chamber. On the film, the area of the air space is measured with dividers and the volume calculated. Next the volume of the inner rod is determined, similarly, and its volume subtracted from that of the chamber. My instrument has a volume of 2.768 c.c.

Next the voltages of the system at the starting and finishing points of the leaf are determined. For this a source of direct current of about 550 volts potential, a potentiometer, and an accurate voltmeter are needed. The finishing voltage should not be much below 200 V as approximately that potential is necessary for saturation. Through the kindness of the local power company, I was able to carry my instrument to the meter shop where such a source of power and suitable meters were available. The scale was marked at 545 V and 195 V. As can be seen in the formula, the 300 in the denominator converts the volts into the electrostatic units of potential.

The only remaining step is to determine the electrostatic capacity of the system in centimeters. For this a standard condenser of known capacity is needed. Rather than attempt to use any laboratory instruments I constructed a simple two-plate condenser of cast brass with amber spacers. The plates were circular and of about 15 cm. diameter and the separation was about 0.5 cm. This was sent to the U. S. Bureau of Standards for determination of capacity. It was reported as 37.0 micromicrofarads which is equal to 33.26 cm. The capacity of the system was then compared with that of the standard by means of my original method,[6] which is summarized as follows:

Place a small amount of radium element on the ionization chamber, screening it well with lead from the rest of the system. Time the fall over any convenient part of the scale. Then connect the standard condenser in parallel with the system and again time the fall over the same scale. Of course, if there is an error caused by leak in the standard condenser, it must be corrected for in the usual manner. As the time of fall is directly proportional to the capacity under similar conditions, we derive the proportion:

$$\frac{C}{C+S}=\frac{T}{I}$$

Where
C = capacity of system.
S = capacity of standard.
T = number of seconds of fall without standard.
I = number of seconds of fall with standard.
When simplified this gives:

$$C=\frac{ST}{I-T}$$

The capacity of the system was thus found to be 43.9 cm.

This completed the determination of the individual factors and they are inserted into the formula thus:

$$r=\frac{43.9(545-195)}{300(2.768)}$$

$$r=\frac{15365}{830.4}$$

$$r=18.53$$

The above calculation shows that when the leaf travels from the starting point on the scale to the finishing point, 18.53 Roentgen units have been delivered to the ionization chamber. If the time of the travel is measured with a stop-watch, it is a simple matter to determine in what length of time a given number of units will be delivered. As the natural leak of this instrument is insignificant, no calculation has to be made for it on average tests.

The instrument may be used as described to determine the total dose, or it may be used in a phantom to determine depth curves. It may also be used as a simple, uncalibrated electroscope for radium comparisons by removing the lead cap and the cable.

SUMMARY

A complete description has been given of the structural form of a satisfactory electroscope-iontoquantimeter which has embodied in it several original features.

A complete description has been given of the method of calculating the r constant of this instrument by purely mechanical and electrical measurements.

Addendum: As soon as it was announced by the U. S. Bureau of Standards that they were ready to calibrate instruments for individuals, the author took his to Washington. Comparisons were made with the Bureau of Standards instrument at several different voltages and filtrations.

At 132 kv. which was the highest voltage then available, filtered through 0.5 mm. copper, my instrument showed the full scale to be equal to 20.2 r. At 125 kv. and 4 mm. aluminum the scale showed 22.2 r. It will be noted that these figures are very close to those which I had calculated as being the values for this instrument and it is reasonable to suppose that at 200 kv. and 0.5 mm. copper the true reading would be even closer.

These figures prove that it is quite practicable to calculate these values as described in this paper provided the instrument is to be used for fairly hard radiation. However a check against a standard instrument is always advisable if such can be made.

The original gold leaf which was put in this instrument over three years ago was not damaged by the trip to Washington, was carried on to New York, and on returning to Charleston, is still in perfect shape.

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DISCUSSION

DR. R. R. NEWELL, San Francisco, Calif. A small ionization chamber like the one Dr. Taft has just shown us has many advantages, but it has the disadvantage that it doesn't agree with the international definition of "r" because the chamber has a "wall." This wall is exposed to the roentgen rays, and the scattered rays and secondary electrons from the wall have their effect on air within the chamber.

Such a small chamber may be calibrated by comparing it with a chamber in which the roentgen ray acts on an effectively isolated cubic centimeter of air, not in contact with anything but air. Such a comparison of the small chamber with the large "all air" or "air wall" chamber demonstrates the fact that measurements with the small chamber do not strictly parallel those with the "all air standard" when the quality of the radiation is changed.

But Glasser and others have shown that the small chamber can be made to agree fairly closely with the international standard throughout the range of useful therapeutic wave lengths if the chamber is made of proper materials. Glasser obtained an extremely close correspondence by impregnating the carbon walls of his chamber with the salts of magnesium and aluminum. We have obtained a correspondence within 10 per cent for wave lengths effective 0.17 Å to 0.45 Å by making the wall of a 1 c.c. chamber of very thin Japanese lens paper coated with a very thin layer of graphite in glue, and using a central electrode of aluminum of carefully selected size. The surface of aluminum exposed gives the proper correction in one direction for the error produced by the carbon wall in the other direction.

DR. G. FAILLA, New York City. I think Dr. Taft has constructed a simple instrument of the electroscope type which is well adapted for certain practical measurements. However, the use of such an instrument as a standard for the *direct* determination of roentgen-ray amounts in r-units is hardly to be recommended.

Dr. Newell has mentioned the difficulties due to the influence of the walls and electrode of the chamber when the quality of the radiation is varied. In addition, the method of direct calibration of this instrument when used as a standard is not so simple as it might appear from the description. Accordingly I would say that it is preferable to calibrate a device of this type by comparison with a large air chamber and then use it for practical measurements in the radiological clinic.

The charging device used by Dr. Taft is certainly very simple and should prove satisfactory. The cable joining the ionization chamber to the electroscope proper is very good. I believe Dr. Weatherwax was the first one to make a cable of this type with amber beads, about nine years ago. We have had very good success with similar cables

Dr. Taft (closing). I know that certain errors are encountered in the use of small ionization chambers. I am perfectly familiar with things that have been done along that line.

I did not bring this up with the idea of suggesting that it be used as a micro-instrument with which we can measure dosage absolutely. I found it very handy for measuring phantom doses and I think it is very satisfactory for measuring day-to-day doses. I realize full well that this instrument has not the accuracy of the large ionization chamber, but we have to realize that when we measure ionization with the large chamber we are not getting back-scattering from the patient. I believe you will meet with more success if you measure doses with small chambers on patients.

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Neck and Chest

Bársony, Th.: Calcium shadows in the region of the soft tissues of the neck 83

Doub, Howard P.: Roentgen diagnosis and treatment of thymomata 83

Arons, Isidore: Sarcoma of the thyroid gland 83

Chaumet, G.: Complementary researches on pulmonary tuberculosis of adults 84

Assmann, H.: Infraclavicular foci of infiltration as evidence of incipient tuberculosis of the lungs in young adults 84

Mathes, Mary E., Reichert, F. L., and Holman, Emile: An experimental method for the radiographic demonstration of the bronchial and pulmonary arteries 84

Priesel, Richard: The roentgen appearance of the azygos lobe 85

Singer, S.: On the differential roentgen diagnosis of intrathoracic diseases 85

Popović, Laza: Studies on bronchography ... 85

Bordet, Emile: Variations of the cardio-aortic shadow due to obesity or emaciation 85

Gaudin, Charles: Orthodiagrammeter for radioscopic examinations of the heart 86

Stumpf, Pleikart: Isography and cinematography of the heart 86

Ritvo, Max: Hernia of the stomach through the esophageal orifice of the diaphragm .. 86

Abdomen

Dioclès: Compressor and selective apparatus for the relief study of the digestive tract. 87

Berg, Hans H.: Relief studies of the gastro-intestinal canal 87

Darbois, Huet, J.-A., and Sobel: The roentgen diagnosis of gastric syphilis 87

Broc, Renè, and Jaubert de Beaujeu, A.: Congenital biloculation of the stomach with an intrathoracic pocket or hernia of the diaphragmatic hiatus 87

Dwyer, Maurice F., and Blackford, John M.: Interpretation of gastric symptoms. 87

Fanardshew, Bartholomäus: The diagnosis of niches in duodenal ulcer 88

Vorhaus, Martin G.: Recognition of some of the less common diseases; duodenal-jejunal diverticula; mucocele of the appendix and the cecum 88

Friedenwald, Julius, Morrison, Theodore H., and Feldman, Maurice: Chronic duodenal stasis observations in twenty-four cases 88

Bargen, J. Arnold, Copeland, Murray M., and Rankin, Fred W.: Tuberculosis of the sigmoid colon simulating a primary malignant lesion 89

Ginzburg, Leon, and Benjamin, Emanuel W.: Lipiodol studies of post-operative biliary fistulae 90

Benhamou, Ed., and Marchioni, R.: Roentgenoscopy and roentgenography of the spleen 91

Gynecology and Obstetrics

Lynch, Frank W.: Uterine fibromyoma 91

Skeletal System

Kienböck, Robert: On severe chronic infantile polyarthritis and its sequelae—general arrest of development and micromelia "pseudo-achondroplasia" 92

Jaulin, and Limouzi: Bilateral congenital subluxation of the head of the radius 92

Michajlow, Mich., and Tscherepnina, M.: The cartilaginous islands of the vertebrae and their roentgen appearance 92

Santos, José V.: Giant cell tumor of the spine 92

Sgalitzer, Max: Roentgen study for the demonstration of tuberculosis of the vertebrae in an early stage 93

Ruth, C. E., and Ruth V. A.: Fractures of the hip 94

Meyer, M., and Sichel, D.: Roentgen study of a case of osseous mycosis (mycetoma or paramycetoma) 94

Sutherland, Charles G.: Roentgenographic characteristics of lesions of bone 94

Kopylow, M. B., and Runowa, M. F.: A contribution of the knowledge of marble bones 95

Paisseau, Laquerrière and Schérer: Roentgenograms of a somewhat peculiar case of sclerodermia 95

Fusari, A.: Tuberculosis of the acromio-clavicular joint 95

Codet and Kauffmann: A case of osteochondromatosis of the elbow 96

Alquier, A.: Multiple enchondromas of both hands 96

Weil, S.: Unusual form of multiple developmental disturbance of the fingers in adolescence 96

Schrader, Erwin: Three-jointed thumbs ... 96

Piffault and Barreau: Roentgenograms of the hands. Lesions of the terminal phalanges 96

Belot, Kimpel and Nebout: A rare case of ectrodactylia 96

Hallermann, W.: On the knowledge of osteitis deformans Paget of the spinal column 96

LYON, ERNST: The appearance of the intervertebral discs in typhoid spondylitis.... 97
SCHMORL, GEORG: Cartilaginous nodes on the posterior surface of the intervertebral discs.... 97
PIFFAULT AND BARREAU: Roentgenograms of the spine.... 97
DELHERM AND MOREL-KAHN: Concerning ivory vertebrae.... 98
GALLAND, MARCEL, AND DE LAS CASAS, HERMAN: Lumbosacral dynamics. A practical study of the technical and clinical radiology (lumbosacral Pott's disease).... 98
LAMY AND LEPENNETIER: Post-traumatic vertebral malformation giving the appearance of osteomalacia. Vertebral osteopoecilia? 99
KREUZ, LOTHAR: Unusual alterations of the epiphyses of the femoral heads in a child. 99
NICHITA, M. I.: Diagnosis and early treatment of congenital dislocation of the hip. 100
SAUER, WALTER: The pathogenesis of Köhler's disease of the os naviculare tarsi.... 100

Blood and Lymph System

GRIFFITH, J. P. CROZER: Mikulicz's disease and the Mikulicz syndrome.... 100

General

EVANS, NEWTON, AND BALL, HOWARD A.: Coccidioidal granuloma.... 101

ROENTGEN AND RADIUM THERAPY

KUHLMANN, B.: The prognosis of lymphogranulomatosis.... 101
ASTI, LUIGI MARIO: Technique of construction of apparatus of Columbia paste for superficial radium therapy.... 101
HOPWOOD, F. L.: The Radium Department of St. Bartholomew's Hospital, London.. 102
WALTER, E.: Radiotherapeutic treatment in a case of partial calcification of the articular capsule of the shoulder.... 102
ROTH, M., AND STEINER, E.: Radiotherapy of acute inflammatory infections.... 102
BRUNER, EDWARD: Concerning the treatment of skin diseases with Bucky borderline rays.... 103
BRAUER, A.: On standardization of roentgen procedures in dermatology.... 103
HOFFMAN, J. M.: Radium in the treatment of diseases with subcutaneous or mucous membrane hemorrhages.... 103
REMER, JOHN, AND BELDEN, WEBSTER, W.: X-ray diagnosis and therapy of thyroid disease.... 103
HOLZKNECHT, G.: The roentgen treatment of morbus basedowii.... 103
SOILAND, ALBERT: The present status of roentgen ray therapy in breast malignancy. 104
EVANS, WILLIAM A., AND LEUCUTIA, T.: The roentgen-ray treatment of intrathoracic tumors.... 104
LANGERON, L., AND DESPLATS, R.: Radiotherapy of the region of the suprarenals; vasomotoric medication.... 105
GAUDUCHEAU, R.: Curie therapy in inoperable cancers of the rectum with the method of Neumann and Coryn.... 106
DEL BUONO, P.: Pathogenesis and roentgen treatment of essential metrorrhagia in young subjects.... 106

MISCELLANEOUS

LACASSAGNE, A.: The importance of filtration and superiority of pure gamma radiation in the radiotherapy of malignant tumors. 106
COHN, MAX: The stereoscopic visualization of the skin in roentgenograms.... 107
STEPHANI, JACQUES: The use of the Bucky diaphragm in pulmonary roentgenograms 107
BRAMS, JULIUS, AND DARNBACHER, LEO: The effect of x-rays on the gall-bladder; experimental production of an x-ray cholecystitis 107
CASATI, A.: "Zones of action" in irradiated bodies.... 107
CANTI, R. G.: Biological effects of radium irradiation.... 108
BODE, H.-G., AND RIECKE, E.: On the histology of sensitized roentgen irradiated skin.... 108
HENRARD, E.: Electrical shock at 110 kv., laboratory accident.... 108
PFALZ, G. J.: The immuno-biologic effect of mild roentgen irradiations on the bactericidal power of the blood.... 109
GLOCKER, R., AND REUSS, A.: Measurements in radiation protection.... 109
GUNSETT, A.: The evaluation of the cutaneous reactions in r (electrostatic) units and in R (Solomon) units, with some remarks on the dependence on the wave length of the number of r leading to the same cutaneous reaction.... 110
GUEBEN, GEORGES: Concerning the technique of measurement of penetrating radiations 110
STRAUSS, SIEGMUND: Borderline-ray mecapion and further improvements in the roentgen mecapion.... 111
KÜSTNER, HANS: The role of the large and small ionization chamber in roentgen measurements.... 111
CHANTRAINE, H., AND PROFITLICH, P.: Artificial radium rays?.... 111
DAUVILLIER, A.: The application of the principles of television in roentgenology; the "radiophot".... 111
BRAUN, R., AND KÜSTNER, H.: The physics of the small thimble ionization chamber. III. The accuracy of the absolute determination of the roentgen unit with the thimble chamber and large air chamber.... 112

ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Neck and Chest

Bársony, Th. Kalkschatten im Bereiche der Nacken-Weichteile. (Calcium shadows in the region of the soft tissues of the neck.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 809–812.

By taking roentgenograms of the neck in true lateral position calcareous deposits were found in the soft tissues opposite the spinous processes of the lower cervical vertebrae. These calcifications may account for the pain in the neck of many patients examined.—*T. Leucutia.*

Doub, Howard P. Roentgen diagnosis and treatment of thymomata. *Radiology*, March, 1930, *14*, 267–281.

In the view of the author, too large a percentage of primary tumors of the thymus have passed unrecognized before autopsy. While the cases are uncommon they are not so rare as has been thought. The sarcomatous type of tumor predominates but a carcinomatous type of tumor also occurs. Roentgen examination of the chest will reveal the tumor as a more or less circular, sharply defined, nonpulsating mass occupying the anterior mediastinum. Roentgen therapy is indicated as soon as the diagnosis is made; the tumors are quite sensitive to radiation therapy and their prompt regression can usually be expected.—*J. D. Camp.*

Arons, Isidore. Sarcoma of the thyroid gland. *Ann. Surg.*, Jan., 1930, *91*, 44–56.

Malignant disease of the thyroid gland is admittedly infrequent. Of this small group, the epithelial tumors predominate over those of mesoblastic origin. The thyroid anlage is an ectodermal derivative, which shares, with the remainder of the alimentary tract and its allied organs, a rare disposition to sarcomatous development. The gross anatomic appearance, the age of incidence, and the clinical course of thyroid carcinoma and sarcoma are so similar that it is almost a clinical impossibility to differentiate preoperatively between them.

In regard to incidence, the ratio of carcinoma to sarcoma is variously given as 10 to 1, or even 4 to 1. The greatest incidence of thyroid malignancy occurs in those particular geographic areas where endemic goiter is prevalent. Other frequently mentioned etiologic factors are trauma and previous inflammation of the gland. Balfour has seen several cases of malignancy which developed subsequent to the injection of various irritants into large thyroids. Most sarcomas occur in the fifth and sixth decades of life. Arons found the average age to be fifty-three years.

The difficulty in diagnosis persists until the capsule of the gland is perforated by the growth. The rate of growth and approach of death are much more rapid in sarcoma than in carcinoma, but this is a weak criterion for differential clinical diagnosis. Other conditions to be differentiated are benign adenoma, tuberculosis and sudden hemorrhage into a cystic cavity in a thyroid. The occurrence of branchiogenic cysts and cysts of the cervical sinus along the anterior border of the sternomastoid muscle and the similar location of aberrant thyroid malignancies should also be remembered.

Classification of sarcomas of the thyroid: (1) Spindle cell sarcoma, of which the fibrosarcoma is a desmoplastic type. This is the most common variety of sarcoma of the thyroid gland. (2) Round cell sarcoma, including a type that resembles the malignant lymphocytoma. (3) Mixed cell sarcoma, of which the so-called giant cell sarcoma is a subgroup. (4) Carcino-sarcoma. (Epitheliosarcomas.)

Metastases occur chiefly to lungs, liver, bone, kidneys and gastrointestinal tract.

Radiation treatment of thyroid sarcoma. Perthes believes that sarcoma of the thyroid is as favorable for radiation therapy as sarcoma of the lymph nodes or tonsil. Schädel, on the contrary, believes that sarcoma of the thyroid does not react well to irradiation. The radiosensitivity of thyroid neoplasms increases in the following order of ascendancy: fibrosarcoma, carcinoma, mixed cell sarcoma, round cell sarcoma. The relative radioresistance of fibrosarcoma is due to its fibrous

character. For this reason radium is preferred to roentgen therapy, because the former exerts a strong action directly on the tumor cells, whereas the latter injures indirectly to some extent by vascular and connective tissue changes. Moreover, if the growth is well localized in the thyroid, radium is preferable to the roentgen ray because the latter tends to injure the remaining normal thyroid tissue. Parathyroid tetany has followed heavy generalized irradiation of the thyroid region.

The metastases in the later stages of the disease are not controlled well by irradiation. For such cases roentgen therapy is a more suitable palliative measure. Irradiation for thyroid sarcomas may be (*a*) postoperative (prophylactic); (*b*) preoperative; (*c*) complete treatment for inoperable cases (palliative).

Interstitial radium therapy can be applied in several ways. A postoperative drainage tube inserted in the wound bed may contain radium capsules in tandem to give about 650 millicurie-hours (Bowing). After surgical exposure of the tumor mass, steel needles containing radium salt or emanation may be placed in parallel arrangement throughout the lesion. The filter in such a case is the equivalent of 0.5 mm. silver. Radon implants in the form of gold or platinum "seeds" with filtration of 0.3 mm., can be inserted into the tumor by means of hollow needles and stylet. External irradiation by means of a radium pack or moulage applicator can be given to the limit of skin tolerance. In postoperative cases such treatment should be withheld until the incision is healed.

The usual expectancy of life is two or three years after the inception of the disease. The disease is almost invariably fatal. The cures reported for sarcoma of the thyroid occurred in those instances where the discovery of sarcoma was made by pathological examination after an operation for presumably benign goiter. This really represents malignancy in a preclinical stage and naturally is the only type which affords a prospect of cure. Of the 17 cases recorded by Arons, radium and roentgen rays were used in several cases and seemed to hold growth in check for a time.—*R. S. Bromer.*

CHAUMET, G. Recherches complémentaires sur la tuberculose pulmonaire de l'adulte. (Complementary researches on pulmonary tuberculosis of adults.) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 42–47.

The various paths of extension of pulmonary tuberculosis in adults are discussed and the conclusion is arrived at that the propagation may occur either by perihilar diffusion, by interlobar pleuritis or by bronchial densification and ramification.—*T. Leucutia.*

ASSMANN, H. Infraclavicular foci of infiltration as evidence of incipient tuberculosis of the lungs in young adults. *Radiology*, Feb., 1930, *14*, 93–98.

During the last eight years the author has encountered what he believes to be a characteristic type of pulmonary lesion in the early stages of tuberculosis of the lungs, particularly in young adults. The lesion, as seen with the roentgen ray, consists of an isolated rounded focus of varying density, usually situated just below the clavicle, in the lateral part of the pulmonic field, more rarely in the upper portion of the lower lobe. Such a lesion is usually sharply circumscribed and definitely contrasted but it may have little density and show a gradual transition into the normal pulmonic field. It is of fundamental importance to understand that, in contradiction of the generally accepted idea that tuberculosis of the lungs nearly always begins in the apices, the type of lesion described, the infraclavicular focus, is associated with absolutely normal apices. From this focus a general tuberculosis may develop, but with timely treatment a favorable prognosis may be given.—*J. D. Camp.*

MATHES, MARY E., REICHERT, F. L., and HOLMAN, EMILE. An experimental method for the radiographic demonstration of the bronchial and pulmonary arteries. *Proc. Soc. Exper. Biol. & Med.*, Jan., 1930, *27*, 278–282.

To determine the exact conditions present within the pulmonary and bronchial circulation following the introduction of infected emboli, a method for the roentgen demonstration of the two circulations was developed. The bronchial artery is best injected with the lung *in situ*. Under chloroform or ether anesthesia the chest is opened by splitting the sternum exactly in the midline. Just before entering the

pleural cavity the animal is killed with the anesthetic to prevent injury to the inflated lung. The various arteries are ligated so as to limit the injection to the thorax. The most satisfactory injection mass is that of Hill using a suspension of 20 per cent bismuth oxychloride in an 11 per cent solution of gum acacia. Berlin blue was added to distinguish the bronchial from the subsequent pulmonary arterial injection. The heart and lungs are removed, the vessels remaining plugged with bismuth. The lung is then inflated to distend all areas without rupturing the air sacs. The lung is then deflated to an intrabronchial pressure of 10 mm. mercury which is the optimum respiratory distention of the canine lung. Stereoscopic roentgenograms of the injected lung enable one to study accurately the size and distribution of the bronchial artery. After this the pulmonary artery may be injected in the excised lung by inserting a cannula through the right ventricle into the pulmonary artery.—*B. Cohen.*

Priesel, Richard. Der Lobus venae azygos im Röntgenbilde. (The roentgen appearance of the azygos lobe.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 804–809.

The author observed 5 cases of azygos lobe occurring in children (at the ages of 2¼, 4, 7, 9 and 10½). In one of the cases a post-mortem examination was performed by a special method (so as to preserve as much as possible the conditions in vivo) and it was found that the vena azygos showed a course which is entirely different from that usually observed. From this the author deduces that the azygos lobe is a developmental anomaly (due to anomalous development of the vena azygos).—*T. Leucutia.*

Singer, S. Zur röntgenologischen Differentialdiagnose intrathorakaler Erkrankungen. (On the differential roentgen diagnosis of intrathoracic diseases.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 787–798.

Three cases of intrathoracic lesions are described in rather lengthy detail in order to prove that the differential diagnosis of intrathoracic tumors still offers difficulties.

The first case was that of a tumor of the anterior mediastinum which was clinically diagnosed as a substernal thyroid and which on post-mortem examination proved to be an aneurysm. In the second case the clinical diagnosis was that of a malignant tumor of the right lung complicated by pneumonia and the post-mortem examination revealed the presence of a lobar pneumonia (in the stage of hepatization) of the right upper and middle lobes without any evidence of tumor. The confusing factor in the roentgen diagnosis of this case was the lack of involvement of the upper portion of the right lung. This at post mortem proved to be due to the presence of an accessory venous azygos lobe. In the third case a clinical diagnosis of carcinoma of the bronchus with metastases to the mediastinal lymph nodes was made while at post mortem a lymphogranulomatosis of the mediastinum with extension to the roots of the lungs was found.

The author expresses the opinion that the diagnosis of intrathoracic tumor cannot be made on the basis of a roentgen examination alone.—*T. Leucutia.*

Popović, Laza. Studien aus der Bronchographie. (Studies on bronchography.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 821–833.

Lipiodol enters the bronchial tree in the direction of the least resistance and under the influence of its own weight. If only a small quantity is injected at a time the accommodation of the bronchial tree to the foreign substance is gradual and without much reaction, but if a large quantity of lipiodol is injected at a time the reaction is very pronounced and may appear in the form of tonic spasms or severe peristalsis. The peristaltic waves are especially well brought out when the patient is lying on the side on which the lung is injected.

The mechanism of the spasms and peristalsis is described in lengthy detail.—*T. Leucutia.*

Bordet, Emile. Les variations de l'ombre cardio-aortique dues a l'engraissement ou a l'amaigrissement. (Variations of the cardio-aortic shadow due to obesity or emaciation.) *J. de radiol. et d'electrol.*, Jan., 1930, *14*, 33.

Since obesity leads to elevation of the diaphragm and emaciation to lowering of the diaphragm it is only natural that in such individuals the cardio-aortic shadow should present varying pictures. Generally speaking the variations resemble those of a normal heart

in deep expiration and inspiration and consequently they are of a mechanical geometric and not of a pathological character.—*T. Leucutia.*

GAUDIN, CHARLES. Orthodiagrammètre pour examens radioscopiques du coeur. (Orthodiagrammeter for radioscopic examinations of the heart.) *J. de radiol. et d'electrol.*, Jan., 1930, *14*, 30–32.

Lian, Guénaux and Renault in 1925 presented a ruler for the determination of the angle of disappearance of the heart apex. The author has simplified this ruler (nomogram). The method of its use is briefly described.

The author has also constructed a special compass for the determination of the depth index of the apex of the heart. This is also described briefly and illustrated with photographs.—*T. Leucutia.*

STUMPF, PLEIKART. Die Isographie und Kinematographie des Herzens. (Isography and cinematography of the heart.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 798–804.

In a previous article (see abstract, this Journal, April, 1929, p. 394) the author described in detail the procedures for the densographic and kymographic tracings of the heart.

In the present article a densographic table is presented which now automatically connects the points of equal densities of the heart shadow, the lines so obtained being called, because of their similarity to the contour lines of relief maps, isograms. Densography is of considerable value in the study of the volume changes of the heart, permitting conclusions of no small importance with respect to the massive hypertrophy of certain portions of the heart.

The author has also worked a new method for the kymography of the heart. This consists in placing a lead shield with small slits (1 mm. wide) at regular distances (every 12 mm.) between the patient and the roentgen film and in moving the film (by means of a motor, in a direction perpendicular to the slits and for a distance corresponding to the space between the slits) during the time of actual exposure. The roentgenograms so obtained are called surface kymograms. They can be studied either as flat films for the changes in the contour of the various portions of the heart, or as moving films, for the changes in shape of the entire heart. In this latter case a special optical device is used if the viewing is done individually or cinematography if the film is demonstrated to a larger audience. The optical procedure consists in viewing the film (which is moved in front of a lamp behind a shield provided with slits at distances exactly identical to those used on the lead shield) through rotating glass cubes which serve the purpose of enlarging the individual images projected through the small slits until the impression of a continuous image is obtained. For the cinematographic reproduction of the surface kymograms a specially constructed apparatus, the cinegraph, is used which permits the automatic printing of the moving kymogram with any speed desired.

The conclusion is reached that densography is of value in accurately registering the changes in mass (density) of the heart while surface kymography permits the analytic study of individual portions of the heart both from a morphologic and functional standpoint.—*T. Leucutia.*

RITVO, MAX. Hernia of the stomach through the esophageal orifice of the diaphragm. *J. Am. M. Ass.*, Jan. 4, 1930, *94*, 15–21.

An "esophageal orifice hernia" is a protrusion of the stomach through the esophageal opening of the diaphragm into the thorax. Roentgenographic examination with the opaque meal has made this diagnosis more common. Sixty cases were found by the author among 8000 gastrointestinal cases. The condition is either congenital or acquired. The size of the hernia in the cases reported varies from that of a walnut to one involving half of the stomach. Forty-one were females and 19 were males. Ages varied from twenty-one to seventy-two years, but only adults had been examined.

Symptoms most suggestive of this condition are pain in the epigastrium and a sensation of distress following the first few mouthfuls of food. This is relieved by walking or taking a hot drink. Other symptoms are detailed. Roentgenographic examination is the most accurate means of diagnosis. The opaque meal plus the use of the horizontal rather than the upright position is stressed. Differential diagnosis clinically is from gastric and esophageal carcinoma, peptic ulcer, gall-bladder disease

and angina pectoris. Roentgenographically diaphragmatic hernia of other types, lower esophageal and gastric diverticula, cardiospasm, cardio-esophageal relaxation and eventration must be excluded.

Treatment is chiefly dietetic and preventive. Surgery is indicated only in the rarer cases of severe symptoms.—*G. R. Miller.*

Abdomen

Dioclès. Compresseur et appareil sélecteur pour l'étude du relief tractus digestif. (Compressor and selective apparatus for the relief study of the digestive tract.) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 49–53.

The author describes in detail the compressor as well as the apparatus which he uses for the roentgen examination of the digestive tract. The method of procedure is briefly as follows: Following the ingestion of 200 gm. gelobarium, the usual roentgenoscopic examination is made. If there is indirect evidence of ulcer, the point of pain is exactly localized and by means of the selector serial roentgenograms (in a vertical position without compression) are taken. The films are immediately developed and if the lesion is not visible additional roentgenograms are taken in the horizontal position with application of the compressor. In exceptional cases a series of stereoroentgenograms is also made.

It is hoped that by this procedure many lesions which heretofore have remained undetected can be demonstrated roentenologically, thus improving the method of accurate diagnosis.—*T. Leucutia.*

Berg, Hans H. Reliefstudien am Magendarmkanal. (Relief studies of the gastrointestinal canal.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 844–855.

This is a lecture delivered at the Twentieth Annual Meeting of German Roentgenologists in Vienna in April, 1929. The value of relief diagnosis in tumors, ulcers, and inflammations of the gastrointestinal tract as well as in certain changes of the neighboring organs was demonstrated by means of numerous roentgen slides, some of which are reproduced.—*T. Leucutia.*

Darbois, Huet, J. -A., and Sobel. A propos du diagnostic radiologique de la syphilis gastrique. (The roentgen diagnosis of gastric syphilis.) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 47–49.

Gastric syphilis may present (*a*) the ulcerous, (*b*) the stenosing, and (*c*) the sclerous-gummous or the diffuse sclerous forms.

The three forms are briefly discussed and 7 cases of gastric syphilis which were observed by the authors are included.—*T. Leucutia.*

Broc, Renè, and Jaubert de Beaujeu, A. Biloculation congénitale de l'estomac avec une poche intrathoracique ou hernie du hiatus diaphragmatique. (Congenital biloculation of the stomach with an intrathoracic pocket or hernia of the diaphragmatic hiatus.) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 13–22.

A case of biloculation of the stomach is described in a boy five years of age. The condition was discovered accidentally during an examination for whooping cough which had failed to clear up. The boy developed attacks of vomiting following the intensive cough and the roentgen examination was made to learn the cause of the vomiting spells.

Roentgenoscopy of the chest revealed an epiphrenic pocket situated to the right of the heart which on examination by means of a barium meal proved to communicate freely with the stomach, giving the impression of a biloculation of the stomach. According to Åkerlund such a roentgenoscopic picture is characteristic of two conditions: (1) congenital epiphrenic diverticulum of the esophagus, and (2) gastric hernia through the diaphragmatic hiatus. According to the authors a third condition, that of congenital biloculation of the stomach, must be included. The importance of these three conditions is discussed and their mechanism is illustrated by schematic drawings.—*T. Leucutia.*

Dwyer, Maurice F., and Blackford, John M. Interpretation of gastric symptoms. *Radiology*, Jan., 1930, *14*, 38–43.

The conclusions drawn from a study of 3000 consecutive patients requiring a gastrointestinal examination are presented. It is well known that the majority of patients who complain of gastric symptoms do not have organic disease and this is corroborated by the present series.

Only 15 per cent of the patients had organic lesions of the stomach or duodenum to account for the symptoms; duodenal ulcer was found in 8.1 per cent and was the most common organic finding in the stomach or duodenum. Gastric ulcer was only a fifth as common as duodenal ulcer. Cancer was found in 3.6 per cent of the patients who had gastric symptoms; 80 per cent of the cancers apparently originated in a resectable area of the stomach. Disease of the gall-bladder was the most frequent cause of the symptoms, and was regarded as responsible for the dyspepsia in 21.3 per cent. In 59 per cent of all cases the cause of dyspepsia was not due either to functional or organic conditions in the stomach, duodenum or gall-bladder.—*J. D. Camp.*

FANARDSHEW, BARTHOLOMÄUS. Zur Frage der Nischendiagnostik bei Ulcus duodeni. (The diagnosis of niches in duodenal ulcer.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, *40*, 1088–1096.

For the past two years the author has routinely used Berg's method for the roentgen diagnosis of duodenal ulcer and found that the examination in the second oblique position with direct graduated bulbar compression is of considerable value, especially in the ulcers localized to the anterior and posterior walls of the duodenum.

Several cases are briefly described and illustrated with roentgenograms in order to prove the value of the method. In connection with this it is emphasized that a complete filling of the duodenal bulb is essential for the demonstration of ucers localized to the anterior or posterior walls of the duodenum. The evidence of a concavity around the niche signifies the presence of an old ulcus callosum. This concavity is especially marked in the ulcers of the anterior wall, while in ulcers of the posterior wall it might be entirely absent.

The examination in the second oblique position occasionally leads to the detection of niches in the anterior or posterior recessus.

The rather infrequent aboral bulbar ulcers usually lead to megabulbus. In such instances an examination with marked compression is necessary. An irregular serrated contour of the duodenal bulb indicates the presence of an ulcer.

Gas in the hepatic flexure (of the colon) or ascaris worms (in the duodenum) occasionally lead to considerable deformity of the bulb giving the impression of a niche.

If there is a lateral kinking of the descending portion of the duodenum the visualization of the bulb in the second oblique position may become very difficult. The best demonstration of a relief niche is obtained with graded compression applied sagittally to the bulb.—*T. Leucutia.*

VORHAUS, MARTIN G. Recognition of some of the less common diseases; duodenal-jejunal diverticula; mucocele of the appendix and the cecum. *J. Am. M. Ass.*, Jan. 18, 1930, *94*, 165–169.

The literature of duodenal-jejunal diverticulum is reviewed. One case of true diverticulum and one case of pseudodiverticula are reported. Both were diagnosed roentgenographically, the former correctly, the other incorrectly because of the appearance suggested by pinching of bits of the jejunum by adhesions.

The literature of mucocele of the appendix is reviewed. A case is reported which showed roentgenographically a patent opening between the cecum and the dilating mucus-secreting portion of the appendix. Hence the condition can form in the presence of bacteria. Attacks of symptoms were recurrent before operation. —*G. R. Miller.*

FRIEDENWALD, JULIUS, MORRISON, THEODORE H., and FELDMAN, MAURICE. Chronic duodenal stasis observations in twenty-four cases. *Am. J. M. Sc.*, Dec., 1929, *178*, 796–805.

This is a consideration of the etiology, incidence, symptomatology, diagnosis and treatment of chronic duodenal stasis as based upon observation in 24 cases.

As to etiology, aside from congenital factors, the following condition favor its formation; adhesions, compression of the duodenum and prolapse of the colon into the pelvis. In addition, spinal deformities, growths involving the abdominal organs and pressure due to ptosis of the right kidney are at times responsible for the condition. According to Bloom and Arens as well as others, chronic duodenal stasis should not be considered as a distinct clinical entity, but only as a roentgenologic phenomenon the result of lesions such

as cited above. This view, however, has not been accepted by most authorities.

As to incidence, the condition may occur at any age but is most common during middle life. It occurs twice as frequently in women as in men, although in the series here reported there were 18 males and 6 females.

The symptomatology is not usually characteristic. There are periodic attacks of nausea and vomiting, so-called bilious attacks. There is usually constipation with occasionally periods of diarrhea. Change in posture may afford relief of symptoms. Loss of weight and strength is not unusual and neurasthenic manifestations are common. During the interval of freedom from attacks, the patient ordinarily enjoys good health. As the disease becomes more chronic, the dilatation extends into the stomach, when nausea and vomiting become persistent. Headaches and migraine attacks are not infrequent. In the more aggravated types a high degree of toxemia may develop.

The condition is at times associated with peptic ulcer, cholecystitis, pancreatitis and mucous colitis, the first of these being the most frequent.

As to diagnosis, the patients are frequently of the asthenic habitus and usually have visceroptosis. The roentgen examination affords the best and often the only means of diagnosis. The fluoroscopic observation gives the most information and this is most satisfactorily made with the patient in the upright posture when viewed semilaterally with the right side nearest the screen. However, the obstruction can ordinarily also be well observed when the patient is recumbent and satisfactory films may be obtained in either position. Retention in the duodenum can be considered positive when the barium is retained longer than a period necessary to complete the passage of the two gastric-peristaltic waves. In marked cases gastric and duodenal six-hour residues are not uncommon. The dilated duodenum can frequently be most satisfactorily observed from one to two hours following the barium meal. Antiperistalsis with regurgitation into the stomach may be noted. A rather characteristic picture is observed four or five hours following the barium meal in the form of a saucer-shaped residue in the second and third portions of the duodenum.

In considering the diagnosis it should be recognized that duodenal stasis is not a rare condition and that it is not infrequently overlooked. It is always important in order to be certain that the stasis is permanent that repeated roentgen examinations be made. In all obscure forms of migraine a thorough roentgen study of the duodenum should be made.

As to treatment, in many instances medical management is quite satisfactory and with conservative and postural treatment marked improvement frequently takes place. The cases due to visceroptosis are especially amenable to medical treatment.

When the symptoms are severe or when adequate medical treatment no longer suffices in affording relief, surgical intervention is indicated, the most satisfactory procedure in most instances being duodenojejunostomy. When performing this operation, it is most important to undertake a complete investigation of the abdominal viscera so that all complications may as far as possible be corrected during the time of this procedure. Of the 24 cases in this study, 23 were treated medically with at least satisfactory temporary relief.—*Karl Kornblum.*

Bargen, J. Arnold, Copeland, Murray M., and Rankin, Fred W. Tuberculosis of the sigmoid colon simulating a primary malignant lesion. *Ann. Surg.*, Jan., 1930, *91*, 79–84.

The authors report two cases of tuberculosis of the sigmoid colon. They report these cases because of the rare occurrence of tuberculosis of the sigmoid colon, the infrequency of tuberculous peritonitis with tuberculosis of the colon, its close similarity to other obstructive lesions of the colon, and the difficulties encountered in its diagnosis. In each case the roentgenograms showed a filling defect which was supposed to be due to carcinoma.

In commenting on these cases the authors state that tuberculous lesions of the colon, as a primary disease, have been reported. When they occur their site is usually the ileocecal region. Tuberculosis of the sigmoid colon is one of the rare forms of tuberculosis of the colon. Definite proof does not exist that the primary lesion in these 2 cases was in the sigmoid colon but several observations suggest this. The surgeons who performed exploration in these cases noted that the greater bulk of the lesion was in the left lower part of the abdomen.

Obstruction occurred in the sigmoid colon. The absence or scantiness of the bleeding in the presence of a large obstructive lesion argues against the presence of a malignant condition. Rankin and Yeomans previously have noted the similarity of the roentgenographic defects produced by tuberculous and malignant lesions. The absence of tuberculous lesions elsewhere than in the sigmoid colon is noteworthy. With these facts in mind, it would seem hardly necessary to search for two types of lesions, that is, for both a malignant and a tuberculous condition to explain the pathologic data.

Yeomans previously made an interesting observation, that tuberculous ulcers of the sigmoid colon encircle the bowel, following the course of the blood vessels as in the ileum. This might explain the similarity of the filling defect as detected roentgenologically, in certain malignant and tuberculous lesions.—*R. S. Bromer.*

Ginzburg, Leon, and Benjamin, Emanuel W. Lipiodol studies of post-operative biliary fistulae. *Ann. Surg.*, Feb., 1930, *91*, 233–241.

During the past two years the authors have on a number of occasions injected lipiodol into postoperative biliary fistulae and then made roentgen studies of the biliary tract. When the films indicated the presence of pathological conditions they were able to check them against the operative findings.

Technique of Injection. In order to evaluate correctly the anatomical conditions present, sufficient lipiodol to distend the ducts must be injected. They have made the injections in their later cases under roentgenoscopic control, This gives a fairly accurate idea of the flow of the injected fluid, prevents over-distention, and reveals any false dissection of the tissue spaces. Prior to the injection, the lipiodol is warmed, and whatever bile is present in the sinus is aspirated. If a tube is still in situ, gravity will suffice to outline the ducts. The tube should be removed, however, before a roentgenogram is made, as it may obscure the picture.

Usually, however, the patient is seen with a small skin opening and a narrow tortuous tract. In these cases it is frequently necessary to use some degree of pressure in order to force the lipiodol into the duct system. For this purpose they use a "Triumph" syringe with a rubber urethral tip attached to its nozzle, and inject under roentgenoscopic control.

Minor points to be emphasized are: the necessity of having the skin wiped dry of lipiodol before the roentgen exposure is made in order to avoid superposition of shadows of the lipiodol lying on the skin surface; the marking of the skin surface by a lead marker or otherwise in case there is a tendency for the contrast medium to collect in a pool in the subcutaneous tissues; the exit of the sinus should be plugged and strapped over to prevent the lipiodol from flowing out of the tract.

They have encountered no untoward effects from the injection of the lipiodol, either locally or generally. Even in cases where they injected under considerable pressure and where there was no communication with the duodenum, later roentgenograms have shown that the lipiodol completely disappeared from the intrahepatic radicles. Whether this is due to reflux through the sinus or whether the hepatic cells have the power of absorbing lipiodol, they are unable to state. In cases where there is a direct communication between the duct system and the duodenum they have noted no evidence of gastrointestinal irritation, even when lipiodol has been used in quantities up to 20 c.c. They have not made any injection in the presence of fever, and believe that it would be inadvisable to attempt one in the face of any active infectious process in the liver or ducts.

Interpretation. In some instances the presence of a postoperative biliary discharge may be the external evidence of an obstruction to the normal flow of bile. Considerable light on the nature and site of such obstruction may be obtained by the injection of lipiodol.

If no obstructing lesion is present the injected lipiodol will pass almost immediately into the duodenum. The sphincter of Oddi does not seem to offer any obstruction to its onward flow. Only a few of the primary ducts are outlined. In the absence of an obstruction it is impossible to outline the intrahepatic biliary radicles to any extent, as the flow meets with much less resistance distally than centrally. So rapidly does the lipiodol pass into the duodenum that the entire common duct is rarely outlined completely. The duodenum is rec-

ognized by its serrated edges due to its normal folds and by the peristalsis stimulated by the inflow of the fluid into the lumen. At times the lipiodol passes very rapidly into the jejunal loops, lying on the left side of the abdomen, so that the presence of the opaque fluid in the intestine may be overlooked unless the roentgenogram includes the entire upper abdomen.

When no obstruction can be demonstrated an early spontaneous closure of the fistula may be anticipated. In 5 cases where the lipiodol showed no obstruction in the bile passages, the biliary discharge gradually ceased and the sinus closed without any further intervention. When an obstruction is present distal to the internal fistulous opening, the lipiodol meeting resistance distally, backs up into the proximal biliary radicles, and may outline the entire biliary tree. This is especially true in obstructions in the hepatic duct. When the obstruction is low down in the common duct, the dilatation of the duct may be so great that it will accommodate all the injected lipiodol and one should hesitate about injecting more fluid to outline the intrahepatic radicles. If the obstruction is complete no lipiodol will be visualized in the intestine either immediately or in later pictures. With an incomplete obstruction small quantities of fluid will trickle through to the duodenum. Lipiodol will demonstrate not only complete obstructions where the stool is alcholic but also incomplete obstructions where the stool contains bile. It will thus demonstrate incomplete strictures and non-impacted stones.

The nature of the obstruction must be arrived at by inference. The most common causes postoperatively are retained stone and complete or incomplete stricture. A small overlooked carcinoma of the head of the pancreas or of the papilla of Vater may at times be the cause. Postoperative strictures, usually traumatic in nature, occur practically only in the supra-duodenal portion of the duct and most commonly at the junction of the cystic and hepatic ducts. Retained common duct stones, on the other hand, cause obstruction near the papilla. An obstruction high in the common or the hepatic duct is more likely to be a stricture. Obstruction low down where the whole common duct is distended and visualized is more likely to be due to a stone. A stone may, but does not necessarily, cause a filling defect in the lipiodol shadow. It is more apt to do so if tightly wedged in a small duct, where the lipiodol cannot surround it, than if it is lying in a distended one where the dense lipiodol shadow will obliterate all finer details.

Lipiodol may be of some assistance in determining the operative procedure. If the stump of the hepatic duct is too short it will of course be impossible to anastomose the short stump to the the duodenum or lower portion of the common duct. On the other hand, if sufficiently long it will indicate that an anastomosis of the stump to the lower end of the duct or to the duodenum is technically feasible.—*R. S. Bromer.*

Benhamou, Ed., and Marchioni, R. Radioscopie et radiographie de la rate. (Roentgenoscopy and roentgenography of the spleen.) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 33–42.

The authors present numerous roentgenograms illustrating the value of the routine roentgen examination in the different diseases of the spleen. In certain instances an enlargement of the spleen is observed already at roentgenoscopy while in others this is discovered only at roentgenographic examinations with serial films. The best technique is to place the patient on his stomach on a Bucky diaphragm and to take a roentgenogram during deep expiration, the tube being centered to the midportion of the last intercostal space on the left side posteriorly. The time of exposure must be very short. No special preparation and no insufflation are necessary. The authors are of the opinion that the use of pneumoperitoneum is indicated only in exceptional cases.—*T. Leucutia.*

Gynecology and Obstetrics

Lynch, Frank W. Uterine fibromyoma. *J. Am. M. Ass.*, Jan. 18, 1930, *94*, 156–162.

Three hundred and ninety-four cases of large fibroids (greater than a four months pregnancy) and 289 cases of small fibroids are reviewed.

One-fourth of the large tumors occurred between forty-five and fifty years; sixty-one per cent were in women under forty-four years. Family history is unimportant. Past history of both large and small types discloses that many of the women have uterine and thyroid deficiency. The cardinal symptom was

hemorrhage in one-third of the cases, pain or pressure in one-third, while no symptoms directly referable to the tumor were found in the remaining third. Not all submucous fibroids showed hemorrhage, and many fibroids not submucous produce bleeding. Tumors developing earlier in life grew more rapidly than those developing in later years. Early diagnosis has reduced the danger from degeneration. Hemorrhage now is the chief factor militating against the patient.

Possibly sterility is pre-existent, and the type of endocrine disturbance which causes it also causes the formation of the tumor.

Of the entire series (683 cases) 4.6 per cent showed malignancy complicating the fibroid.

Surgery, radium and roentgen therapy each has its place in treatment. The first was accompanied by a mortality of 1.34 per cent in this series while one death occurred in the cases treated with radium.—*G. R. Miller.*

Skeletal System

Kienböck, Robert. Über schwere infantile Polyarthritis chronica und ihre Folgeerscheinungen—allgemeiner Wachstumsstillstandund Mikromelie "Pseudoachondroplasie." (On severe chronic infantile polyarthritis and its sequelae—general arrest of development and micromelia "pseudoachondroplasia.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 813–816.

The author presents the report of the postmortem examination of a case which he has repeatedly described previously and which consisted in a very severe polyarticular joint affection with marked secondary disturbances. The condition started at the age of eight with febrile polyarthritis and after several recurrences resulted in a general arrest of growth of the body with kyphoscoliosis, shortening of all extremities, numerous ankyloses, generalized osteoporotic atrophy of the skeleton, kidney calculi and diaphragmatic hernia. In 1902 when the patient at the age of thirty-two was first examined by the author, a very unfavorable prognosis was given. Notwithstanding this fact, the patient lived until 1929, to the age of nearly sixty, and died as the result of an intercurrent disease (carcinoma of the esophagus).—*T. Leucutia.*

Jaulin, and Limouzi. Luxation congénitale bilatérale de la tête du radius. (Bilateral congenital subluxation of the head of the radius.) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 27–29.

The authors describe briefly a bilateral congenital subluxation of the head of the radius in a boy fifteen years of age. The roentgenograms are presented.

The condition may be the result of trauma in utero, injury during delivery, oligoamnios, disturbance of muscular equilibrium due to nerve lesions and intoxications (alcohol, lead). —*T. Leucutia.*

Michajlow, Mich., and Tscherepnina, M. Über die Wirbelknorpelinseln und deren Röntgenbild. (The cartilaginous islands of the vertebrae and their roentgen appearance.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, *40*, 1061–1069.

The anatomical sections of 70 vertebral columns were examined as to the incidence and pathology of the cartilaginous islands. After fixation of the spine in formalin, roentgenograms in the anteroposterior and lateral views were made, then the spine was cut sagittally and the cross-sections photographed.

In 14 cases there was no evidence of pathological changes, in 27 there was evidence of alterations within the epiphyses and vertebral bodies and in 29 there were cartilaginous islands. Only 5 of the cartilaginous islands presented typical roentgen pictures.

The author is of the opinion that the cartilaginous islands are either of traumatic origin or the result of irregular enchondral ossification. In the first instance, there is always evidence of an injury to the cartilaginous plate, due to trauma or to congenital fragility of the cartilaginous structures; in the second instance, there is an irregular proliferation of the cells of the cartilaginous plates into the bodies of the vertebrae. The two processes very often present identical anatomic and roentgenologic pictures. —*T. Leucutia.*

Santos, José V. Giant cell tumor of the spine. *Ann. Surg.*, Jan., 1930, *91*, 37–43.

The author reports a case of giant cell tumor of the spine for three reasons: (1) it is relatively uncommon in the spine; (2) its diagnosis is not

easily made, and (3) there is a marked destruction with collapse of the affected vertebra.

He found, including the case reported in this paper 23 cases of primary giant cell tumor of the vertebra in the literature. The roentgenograms present a characteristic circumscribed area of diminished density with fine fibrillary lines of ossification within the tumor. A secondary collapse of the vertebral body, as in this present case, however, has not been noted before. This case emphasizes the importance of biopsy in establishing a diagnosis and demonstrates that where there is marked destruction and collapse of the vertebra, roentgenograms alone would not be of much diagnostic value in differentiating it from a metastatic malignant lesion.

The lesion, occurring relatively more frequently at the lumbar spine, shows greater tendency to increase rapidly and heal more readily by ossification, spontaneously or following partial removal, when located at the cervical and lumbar spines. All the cases where the cervical and lumbar vertebrae formed the site of the lesion, reveal extension through the vertebrae into the surrounding musculature with the consequent formation of a palpable soft mass within a year of the onset of symptoms. Subsequently an extensive ossification of the lesion occurs spontaneously, or following an incomplete removal. In a way this would indicate that they differ in some respect from the giant cell tumors occurring in long bones, which, as a rule, do not ossify, although ossification is also often noted following pathological fracture through the site of the lesion. This fact and the frequent occurrence of early and extensive ossification of giant cell tumors located in the lumbar and cervical vertebrae, which are undoubtedly the most mobile portions of the spinal column, is so striking and suggestive that it seems that stress and strain may be a probable cause of the enhanced ossification. The associated urinary disturbances which are found in most of the cases reported, as a rule ultimately disappear, although they may persist for a long period of time.—*R. S. Bromer.*

Sgalitzer, Max. Röntgenologische Studien zum Nachweis der Wirbeltuberkulose in einem frühen Stadium. (Roentgen study for the demonstration of tuberculosis of the vertebrae in an early stage.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, *40*, 761–786.

Two forms of tuberculosis of the vertebrae are described: (*a*) the early form without marked deformities of the spinal column, and (*b*) a mild, very chronic form, the so-called spondylitis tuberculosa benigna.

(*a*) The earliest symptoms of tuberculosis of the vertebrae consist in a slight decrease of the physiologic lordosis of the cervical and lumbar portions or a slightly increased kyphotic curvature of the thoracic portion of the spine according to whether the cervical and lumbar, or the thoracic segments of the vertebral column are involved. In other instances there is a central focus of destruction within the body of the vertebra first without any change in the normal alignment, later with collapse of the vertebral body and subsequent deformity of that particular portion of the spine. If the tuberculosis is localized to the thoracic spine, in 80 per cent of the cases there is evidence of a cold abscess at the site of the lesion. This abscess extends in a fusiform shape to both sides of the spine and its widest diameter is, as a rule, at the level of the tuberculous focus. Its differential diagnosis includes thymic enlargement, retrosternal goiter, mediastinal tumor, enlarged bronchial lymph nodes, tumors and diverticula of the esophagus, enlarged right auricle, dilated aorta descendens, mediastinal adhesions, aneurysms of the aorta and sarcoma of the vertebrae. The demonstration of a cold abscess in the cervical and lumbar regions of the spine is possible only in a very limited number of cases.

(*b*) The spondylitis tuberculosa benigna as a rule extends over a period of years without producing any noticeable symptoms and without leading to deformities of the spine. In some instances there is spontaneous healing. The diagnosis of this form of tuberculosis is based on the same criteria as that of the early forms. In this respect the demonstration of a cold abscess is of special value.

Twelve cases, briefly described, are included as examples of the various forms of tuberculosis of the spinal column. The article is richly illustrated with roentgenograms and diagrams.—*T. Leucutia.*

Ruth, C. E., and Ruth, V. A. Fractures of the hip. *J. Am. M. Ass.*, Jan. 18, 1930, *94*, 169–174.

Treatment of hip fractures should be carried out at a hospital. Transportation causes less shock when a Thomas splint is employed. Diagnosis is most satisfactory and least traumatizing by roentgen examination. By this means it can be determined which one of the following six types of fracture is present: (1) Fractures of the head of the femur within the acetabulum; (2) acetabular fractures; (3) fractures of the shaft with separation of the lesser trochanter from both fragments; (4) intertrochanteric fractures in which the lesser trochanter is attached to the proximal fragment; (5) fractures of the base of the neck in which the lesser trochanter is attached to the distal fragment; (6) fractures of the narrow part of the neck.

Various factors influence the deformity and reduction of each of the above. All unnecessary tax upon the patient's strength must be avoided in the treatment of these cases, and a proper consideration of details in a strictly observed routine which minimizes and eliminates a general anesthetic is indispensable to success.

Traction is maintained constantly from one to three weeks, after which time a cast may be applied, also without general anesthetic. Open surgical reduction is condemned. Should union fail in fractures of the neck, however, excision of the femoral head is the most satisfactory procedure.—*G. R. Miller.*

Meyer, M., and Sichel, D. Étude radiographique d'un cas de mycose osseuse (mycétome ou paramycétome). (Roentgen study of a case of osseous mycosis (mycetoma or paramycetoma).) *J. de radiol. et d'électrol.*, Jan., 1930, *14*, 23–26.

The mycoses leading to bone changes are exceedingly rare in Europe. The authors observed a case of paramycetoma of Langeron (the hyphomycetoma of Vuillemin) in a boy of African origin, who for a period of about two years had presented a tumefaction with fistula formation of the right external malleolus. Roentgenograms of the right ankle and foot revealed peculiar bone changes consisting in multiple foci of decalcification surrounded by dense zones of new bone formation and associated with thickening of the periosteum. The lesions although interesting are not characteristic and the only way to make a positive diagnosis is by bacteriological studies.—*T. Leucutia.*

Sutherland, Charles G. Roentgenographic characteristics of lesions of bone. *J. Am. M. Ass.*, Dec. 28, 1929, *93*, 2024–2026.

Before interpretation of bone lesions is attempted perfection of the roentgenogram is essential. Anteroposterior and lateral views, plus a roentgenogram of the unaffected side for comparison, are all desirable. Artefacts must also be ruled out.

Malignant lesions denude the periosteum and invade soft tissue. Benign lesions never do this. Early sclerosing osteogenic sarcoma may resemble osteomyelitis and syphilitic osteitis but the sarcoma will usually show a cortical break. Ewing's type of sarcoma shows "onion skin" lamination of the periosteum plus a uniform expansion of the shaft of the long bone. Invasion of soft parts is not marked. Periosseous fibrosarcomas show areas of absorption in the bone. The shadow of soft tissue is well encapsulated.

Multiple myelomas need roentgenograms of more than one part for diagnosis. There are numerous vacuolated areas throughout the bones, each sharply demarcated. The latter appearance differentiates it from osteoclastic metastasis from mammary carcinoma.

Metastatic lesions may be osteoclastic or osteoplastic. The former give a "melted ice" appearance to the bone. Rarely the two forms are combined. Most commonly osteoplastic metastasis is from prostatic carcinoma. Hypertrophic osteo-arthritis of the lower lumbar vertebra or sacroiliac synchondrosis may stimulate osteoplastic metastasis.

Osteitis deformans (Paget's disease) must be differentiated from osteoplastic metastasis.

Osteoclastic metastasis to the spine may exist without roentgen evidence.

Tuberculosis of the spine differs from osteoclastic metastasis in that the intervertebral disc is affected in the former condition, and the contour of the body of the vertebra is usually altered.

Syringomyelia, osteomalacia and rare metabolic disorders show demineralization of the

bone and narrowing of the anterior borders of the vertebral bodies.

Sarcoma and osteochondritis of the spine may be confused.

Exostosis, osteoma, chondroma and osteochondroma differ in the variations in density.

Fibrocystic disease and giant cell tumor should be differentiated, according to the author. In the former, involvement is usually more extensive and frequently multiple, trabeculation is constant and the expansion of the shaft is more symmetrical.

Multiple congenital exostosis may be a developmental defect with resulting deformities rather than true neoplasm.—*G. R. Miller.*

Kopylow, M. B., and Runowa, M. F. Ein Beitrag zur Kenntnis der Marmorknochenkrankheit. (A contribution to the knowledge of marble bones.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, *40*, 1042–1054.

A case of marble bones is described in a man twenty years of age. Roentgenograms of the hands, feet, ankles, knees, pelvis and spine (which are reproduced) revealed that the process extended practically to the entire skeleton, both the spongiosa and corticalis having been involved. The femora, the right pubic bone and the left scapula presented signs of old healed pathologic fractures.

In connection with this case the author performed numerous investigations concerning the changes in the calcium, phosphoric and magnesium metabolism and found the following figures:

	Marble Bones per cent	Normal Bones per cent	Rickets per cent
Calcium	29.94	24.31	21.30
Phosphate	10.12	33.30	30.54
Magnesium	0.72	0.10	0.53

The values of potassium, sodium chloride, sugar, cholesterin and uric acid of the blood were within normal limits.

The conclusion is reached that marble bones, similar to Paget's disease, is an alteration of the calcium and phosphoric metabolism consisting in hypercalcemia and hyperphosphoremia. In this respect they are antagonistic to rickets and osteomalacia which as is known consist in hypocalcemia and hypophosphoremia. For the same reason the authors prefer to place marble bones in the group of avitaminoses.—*T. Leucutia.*

Paisseau, Laquerrière and Schérer. Radiographies d'un cas un peu particulier de sclérodermie. (Roentgenograms of a somewhat peculiar case of sclerodermia.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, *17*, 278–279.

A girl twelve years of age who for a period of three years was affected with generalized sclerodermia presented rather peculiar bony changes in the roentgenograms of various parts of the body. The changes were localized chiefly to the bones of the legs, hands, wrists and forearms and they consisted in marked demineralization with disappearance of the interarticular lines and with slight deformity. There was also involvement of one of the clavicles and there was evidence of calcareous deposits within the lungs and in one of the knee joints.—*T. Leucutia.*

Fusari, A. Tubercolosi dell'articolazione acromio-clavicolare. (Tuberculosis of the acromio-clavicular joint.) *Radiol. med.*, Dec., 1929, *16*, 1188–1191.

Generally tuberculosis of the shoulder is considered synonymous with tuberculosis of the scapulo-humeral joint. But the author calls attention to the fact that this is not true, but that the disease may be in the acromio-clavicular joint. He describes an illustrative case in a woman aged forty-five who had had tuberculosis of the cervical lymph glands in childhood and in 1928 began to have pain in the right shoulder irradiating along the arm. The function of the shoulder-joint was not impaired. Swelling of the deltoid region developed and in November a large abscess appeared and was evacuated. The scapulo-humeral joint was then immobilized but as the condition persisted she was sent for roentgen examination. It showed a tuberculosis beginning in the acromion process, which was very much atrophied, and extending to the acromio-clavicular joint. The scapulo-humeral joint was normal. Wassermann negative, tuberculin reaction positive. The joint was immobilized and treated with local heliotherapy and a year later there was advanced repair of the lesion.

It is important clinically to differentiate

between these two localizations of the disease for if the process is localized in the scapulo-humeral joint the shoulder must be immobilized in extreme abduction so that as much movement as possible is preserved when the joint becomes ankylosed while if the acromio-clavicular joint is affected a simple Désault's bandage is sufficient.—*A. G. Morgan.*

Codet and Kauffmann. Un cas d'ostéochondromatose du coude. (A case of osteochondromatosis of the elbow.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, *17*, 276–277.

A case is briefly described in a man forty-eight years of age and in connection with this the differential diagnosis from similar lesions is discussed. The grape-like arrangement of the calcareous deposits in the roentgenogram is typical for osteochondromatosis.—*T. Leucutia.*

Alquier, A. Enchondromes multiples des deux mains. (Multiple enchondromas of both hands.) *J. de radiol. et d'électrol.*, Nov., 1929, *13*, 619–620.

A case of multiple enchondroma of both hands is described in a young man who by occupation was a watchmaker. The condition had been present for a period of many years and he requested an examination since it bothered him in his professional work. The roentgenogram of the left hand showing the extensive lesions of nearly all the metacarpals and phalanges is reproduced. Further roentgenograms of the extremities and especially of the feet were however negative.

No treatment was advised since the tumors of the hand did not influence the general health of the patient.—*T. Leucutia.*

Weil, S. Eine ungewöhnliche Form der multiplen Wachstumsstörung der Finger im Adoleszentenalter. (Unusual form of multiple developmental disturbance of the fingers in adolescence.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 671–673.

An unusual developmental disturbance of the finger bones is described in a boy aged fifteen. The roentgenogram of the hands revealed a deformity of the head of the first phalanx of the third and fourth fingers on both hands, clinically resulting in a swelling of the fingers.

The fact that the lesion occurred in adolescence and symmetrically on both hands suggests the possibility of Fleischner's disease (a condition analogous to Köhler-Perthes' disease).—*T. Leucutia.*

Schrader, Erwin. Dreigliedrige Daumen. (Three-jointed thumbs.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 693–694.

Two cases of thumbs with three phalanges on both hands are briefly described and their roentgenograms presented.—*T. Leucutia.*

Piffault and Barreau. Radiographies des mains. Lésions des phalangettes. (Roentgenograms of the hands. Lesions of the terminal phalanges.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, *17*, 270–272.

A peculiar destruction of the terminal phalanges of both hands which occurred following sudden change of temperature (from cold to warm) is described in a Moroccan negro twenty-seven years of age.—*T. Leucutia.*

Belot, Kimpel and Nebout. Un cas rare d'ectrodactylie. (A rare case of ectrodactylia.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, *17*, 274.

The various types of ectrodactylia hitherto described are: lobster claw, absence of the thumb and its metacarpal, monodactylia (only the first or fifth finger being present), and radial or cubital ectrodactylia with absence of either radius or ulna and occasionally of the metacarpal and even carpal bones. The author observed a case of absence of the middle finger which is not included among the above anomalies and which has not previously been described in the literature. The case is unique.—*T. Leucutia.*

Hallermann, W. Zur Kenntnis der Ostitis deformans Paget der Wirbelsäule. (On the knowledge of osteitis deformans Paget of the spinal column.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, *40*, 999–1017.

Whereas the generalized form of osteitis deformans Paget is exceedingly rare, the localized form, involving various segments of the

spine, is rather common. Between May, 1926, and August, 1929, the author was able to collect 70 cases of osteitis deformans Paget localized to the spine. In 90 per cent of the cases the lesion was confined to the spine alone, while in the other 10 per cent other bones of the body were also involved.

The study of the author was based on anatomical specimens which subsequently were roentgenographed. It was found that the changes in the anatomical specimens consisted in thickening of the peripheral and thinning of the central portions of the vertebrae; in a few instances there was a fine porous atrophy of the entire vertebral bodies. Roentgenographically the thickenings manifested themselves in increased opacities while the thinning and the fine porous atrophy appeared as rarefactions.

In the entire series there was only one case of osteitis fibrosa Recklinghausen, indicating that this condition must be very rare. The author describes in detail the changes of the spine in this case and establishes the following roentgenologic criteria as important for the differentiation from localized Paget's disease: The increased density extends not only to the marginal portions of the vertebra but to the entire vertebra, resulting in a loss of demarcation of the central and peripheral portions of the vertebral body. The picture is complicated by the presence of numerous areas of rarefaction irregularly scattered throughout the entire spine. The differentiation of osteitis fibrosa Recklinghausen from metastatic carcinosis of the spine (in carcinoma of the breast and prostate) is made on the basis that in metastatic carcinoma the bone changes which are both of the osteoblastic and osteoclastic type, are very irregular and of a moth-eaten appearance.—*T. Leucutia.*

Lyon, Ernst. Das Verhalten der Bandscheiben bei typhöser Spondylitis. (The appearance of the intervertebral discs in typhoid spondylitis.) *Fortschr. a. d. Geb. d. Rontgenstrahlen*, Oct., 1929, *40*, 635–638.

From numerous roentgen examinations of cases of spondylitis typhosa, the author arrived at the conclusion that the condition produces marked inflammatory changes of the spine resulting in necrosis and new bone formation. There is a tendency to fast recovery and marked regeneration. The intervertebral discs are often involved in the process.—*T. Leucutia.*

Schmorl, Georg. Über Knorpelknoten an der Hinterfläche der Wirbelbandscheiben. (Cartilaginous nodes on the posterior surface of the intervertebral discs.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 629–634.

Three cases of cartilaginous nodes occurring on the posterior surface of the intervertebral discs are described. In the first case, that of a woman forty-eight years of age (who died from pneumonia), the cartilaginous node was at the posterior aspect of the 10th intervertebral disc, protruding 4 cm. into the spinal canal. In the second case, that of a man fifty-two years of age, the cartilaginous node was localized to the posterior surface of the 9th intervertebral disc and was 5 mm. high, 1.5 cm. long and 1 cm. wide. In the third case, that of a man fifty-one years of age, the cartilaginous node was on the posterior surface of the 7th dorsal intervertebral disc, protruding 5 mm. deep into the spinal canal.

Photographs and roentgenograms of the specimens are included.

The cases are presented in support of the theory that cartilaginous nodes are caused by proliferation of the nucleus pulposus following injury to the cartilaginous plates and are not the result of proliferation of remnants of the chorda as hitherto supposed.

Differential diagnosis includes spondylitis deformans and certain new-growths, especially osteochondroma.—*T. Leucutia.*

Piffault and Barreau. Radiographies du rachis. (Roentgenograms of the spine.) *Bull. et mém. Soc. de radiol. méd. de France*, Oct., 1929, *17*, 252–253.

A case of rhizomelic spondylosis is described in a man fifty years of age. Roentgenograms in the anteroposterior view revealed marked opacity of the lower dorsal and lumbar intervertebral spaces, flattening and deformation of the lumbar vertebrae and sacralization of the fifth lumbar vertebra. There was ankylosis of the articulations with ossification of most of the small and especially of the yellow ligaments.

Roentgenograms in the lateral view revealed that the intervertebral spaces had a normal appearance and that the opacity which was

observed in the anteroposterior view was due to the calcified band bridging the intervertebral spaces on the anterior aspect of the spine.

The condition is exceedingly rare and belongs to the type of vertebral rheumatism described by Marie and Lévi.—*T. Leucutia.*

DELHERM and MOREL-KAHN. A propos des vertèbres d'ivoire. (Concerning ivory vertebrae.) *J. de radiol. et d'électrol.*, Nov., 1929, *13*, 598–608.

Souques, Lafourcade and Terris in 1924 for the first time described a bone anomaly which consisted in an increased density with maintenance of the "morphologic integrity and homogeneous appearance" of one single vertebra and which they called ivory vertebra.

In reviewing the literature the authors found that only very few similar cases have been reported since. These cases (a total of 8) are briefly reviewed and discussed. In addition, the authors present 3 of their own cases and reproduce their roentgenograms. In the first case there was involvement of the fourth lumbar vertebra without definite etiology although a malignant condition was suspected. In the second case the involvement extended likewise to the fourth lumbar vertebra and here the condition was the result of an old Pott's disease. In the third case the involvement extended to the tenth dorsal vertebra and no definite etiology could be demonstrated.

On the basis of a study of the cases presented the authors arrive at the conclusion that the roentgen appearance of ivory vertebrae is identical to that of the so-called marble bone disease, except that the ivory vertebrae as a rule are single while marble bone disease is an affection of the entire skeleton. Another criterion of differentiation is that ivory vertebrae always occur in adults and old age while the marble bone disease is an affection of youth.

Pathologically the conditions are distinct entities. Whereas marble bone disease is the result of a generalized systemic disturbance associated with frequent modifications of the blood formula, ivory vertebrae may occur as the result of cancer, tuberculosis syphilis, lymphogranulomatosis, etc. Further observations are necessary in order to completely elucidate this rather interesting problem. —*T. Leucutia.*

GALLAND, MARCEL, and de LAS CASAS, HERMAN. La dynamique lombo-sacrée. Étude pratique de radiologie technique et clinique (le mal de Pott lombo-sacré). (Lumbosacral dynamics. A practical study of the technical and clinical radiology (lumbosacral Pott's disease).) *J. de radiol. et d'électrol.*, Oct., 1929, *13*, 529–547.

The so-called "low back pain" may be the result of sciatica, funiculitis, lumbalgia, rheumatism, Pott's disease, congenital malformations, static disturbances, etc.

The authors made a detailed study (1) of the normal roentgen appearance; (2) of the morphology and normal mechanism, and (3) of the clinical roentgenology of the lumbosacral region.

(1) Normal roentgen appearance. The technique of the roentgen examination of the lumbosacral region in the lateral view is now well known and its value generally recognized. In the anteroposterior view, special procedures are necessary according to whether a demonstration of the body or of the arch of the fifth lumbar vertebra is required.

The elementary principle of a good roentgenogram of the spine is that the incidence of the rays must be as near as possible to the center of the curvature of the particular portion of the spine to be examined. For the midportions of the cervical and thoracic spines this incidence must be anteroposterior, while for the lower segments of the cervical and upper segments of the thoracic as well as for the entire lumbar spine and sacrum it must be posteroanterior. In scoliosis the rays should be directed towards the concavity of the curvature.

For the roentgen demonstration of the body of the fifth lumbar vertebra the patient is placed in abdominal decubitus and the tube is centered over the lumbar curvature, the central ray passing through the second lumbar vertebra. In this manner the fifth lumbar vertebra is roentgenographed tangentially, with very little distortion on the film. If the patient is too fat one has to resort to another procedure. A line is drawn (on the skin) between the inferior border of the anterior iliac crest and the interspinous space of the fourth and fifth lumbar vertebrae and the central ray is directed in the direction of this line with the patient either lying on the abdomen or on the back (with flexed knees), or being in a sitting position.

For the roentgen demonstration of the arch of the fifth lumbar vertebra the patient is placed on the back and the central ray is directed over the umbilicus. Here, too, the fifth lumbar vertebra is roentgenographed tangentially and while there is a marked distortion of the body of the vertebra the arch is very well visualized.

(2) Normal morphology and dynamics of the lumbosacral region. The fifth lumbar vertebra may be of the cuboid or infantile (in 32 per cent of the cases) and of the cuneiform or adult type (in 68 per cent of the cases). The lower surface of the vertebral body and the upper surface of the sacrum (the so-called lumbosacral disc) normally show an angulation of 20°. In standing position this increases to 35°.

The weight of the spine is transmitted from one vertebra to the other through the elastic nucleus pulposus which serves the purpose of mechanical ball bearings. The arches counterbalance the anteroposterior and lateral glidings of the bodies of the opposite vertebrae. The transmission of the weight from the spine to the pelvis and thus to the lower extremities is more complicated. Here the oblique position of the sacrum and the lumbar lordosis are the result of the progressive adaptation of the human to the biped posture.

(3) Clinical radiology. If the nucleus pulposus is partially or totally destroyed as, for example, in Pott's disease, the intervertebral disc collapses and a narrowing of the intervertebral space results. At the beginning the arches will try to correct this deformity but later muscular contractures intervene and a marked kyphosis with deformity of the spine ensues.

The authors also discuss the dynamics of the sacralization of the fifth lumbar vertebra and lumbarization of the first sacral segment, as well as the part certain new bone deposits play in the disturbance of the normal function of the lumbosacral spine (as in some cases of Pott's disease and in rheumatism).

Not infrequently, static troubles (deformity of the fifth lumbar vertebra, lumbar hyperlordosis and sacroiliac fatigue) are the cause of the low backache without there being any dynamic disturbance of the spine. This is important from the point of view of differential diagnosis.

The article is illustrated with numerous diagrams and schematic drawings.—*T. Leucutia.*

Lamy and Lepennetier. Malformation vertébrale post-traumatique d'aspect ostéomalacique. Osteopoécilia vertebrale? (Post-traumatic vertebral malformation giving the appearance of osteomalacia. Vertebral osteopoecilia?) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, *17*, 268–269.

A peculiar malformation of the first lumbar vertebra was observed by the authors in a girl twenty-three years of age who first appeared for examination in November, 1927, following a fall. The roentgen films at that time revealed an irregular decalcification with a flaky appearance of the first lumbar vertebra. It was evident from the examination that the condition had nothing to do with the trauma but that it represented a form of osteomalacia. The patient was immobilized by means of a plaster cast for a period of two years and subsequent roentgenograms failed to reveal any evidence of improvement in the bony condition although clinically all symptoms disappeared. No accurate diagnosis can be made, but the authors are of the opinion that the condition is either that of ivory vertebra or an atypical tuberculosis.—*T. Leucutia.*

Kreuz, Lothar. Ungewöhnliche Veränderungen an den Hüftkopfepiphysen einer Jugendlichen. (Unusual alterations of the epiphyses of the femoral heads in a child.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, *40*, 1034–1041.

An unusual alteration of the heads of the femur and their epiphyses is described in a girl eleven years of age who was observed by the author for a period of three years. At the beginning the condition showed a similarity to Perthes' disease but later, on account of the peculiar roentgen appearance and especially because of the lack of involvement of the femoral necks, it was classified as osteochondroarthropathia juvenilis.

The process occurred bilaterally and contrary to Perthes' disease it consisted chiefly in an oval destruction of the head of the femur with involvement of the epiphyses. During the period of two and a half years the lesion has extended only to the epiphyses and has failed to produce any changes in the femoral necks. No histologic examination was made and consequently nothing is offered in the way of

explanation of the etiology of the disease. —*T. Leucutia.*

Nichita, M. I. Diagnosticul si tratamentul precoce in luxaţia congenitală a soldului. (Diagnosis and early treatment of congenital dislocation of the hip.) *Clujul med.*, Dec., 1929, *10*, 630–634.

After describing in detail the early clinical signs of congenital dislocation of the hip the author emphasizes the following three roentgen signs: (1) obliquity of the cotyloid crest; (2) upward and outward displacement of the femoral epiphysis as compared to the center of the cotyloid cavity, and (3) hypoplasia and delayed development of the femoral head. The first sign, that is the obliquity of the cotyloid crest, appears very early and in several instances it was possible to make a diagnosis on this sign alone.

For the treatment of congenital dislocation of the hip the author advises the method of Putti which consists in the early immobilization by means of a triangular cushion which is applied for a period of at least six to eight months. A roentgen control at intervals of two to three months is advisable.—*T. Leucutia.*

Sauer, Walter. Zur Pathogenese der Köhlerschen Erkrankung des Os naviculare tarsi. (The pathogenesis of Köhler's disease of the os naviculare tarsi.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 679–685.

Five cases of Köhler's disease of the os naviculare tarsi are described. In none of the cases was there evidence of clinical symptoms and the condition was discovered accidentally at roentgen examinations. In connection with these cases, the etiology and pathogenesis of the disease is discussed and the opinion is expressed that Köhler's disease is the result of changes due to developmental disturbances. One of the cases observed by the author for a longer period presented in the first roentgenograms two ossification nuclei of the navicular bone. Later because of the reciprocal pressure of the bone developed by the two nuclei an atrophy of the entire bone resulted. This then proves that the condition is a developmental disturbance.—*T. Leucutia.*

BLOOD AND LYMPH SYSTEM

Griffith, J. P. Crozer. Mikulicz's disease and the Mikulicz syndrome. *Am. J. M. Sc.*, Dec., 1929, *178*, 853–860.

Mikulicz's disease, as described by Mikulicz in 1888, is a chronic symmetrical enlargement of the lachrymal and salivary glands, beginning in the lachrymal glands and perhaps limited to them, but usually gradually extending. The swelling is hard, painless and apparently non-inflammatory. There is no disturbance of the lachrymal or salivary secretion, and the general health is not affected. Mikulicz emphasized the non-participation of the lymphatic glands in the process, and the lack of alteration of the blood. He could discover no cause for the condition, but believed it was an infection of some sort. Pathologic study of a portion of the lachrymal gland which had been removed revealed a widespread infiltration with round cells suggesting lymph-adenomatous tissue.

Enlargement of the lachrymal and salivary glands has been reported in association with other conditions such as leucemia, tuberculosis, syphilis, lymphosarcoma, toxic conditions, gout and the condition described by Heerfordt under the title of "febris uveoparotidea subchronica." Inasmuch as these conditions do not correspond in all respects to the original disease described by Mikulicz, they have been grouped under the title of "Mikulicz's syndrome."

The author reports 2 cases occurring in children one of which is a case of Mikulicz's disease proper while the other presents the Mikulicz syndrome having occurred in association with leucemia.

Writers on this subject have been much concerned with the possible tuberculous nature of the condition. Many pathological reports of the affected lachrymal glands have shown a histologic picture essentially that of tuberculosis yet in only 3 cases has it been possible to establish the diagnosis of tuberculosis unequivocally. In most of the cases it has been impossible to find the tubercle bacillus and inoculations in laboratory animals have given negative results. The author's first case regarded as Mikulicz's disease proper, gave a histologic appearance of tuberculosis in the excised lachrymal gland, yet such a diagnosis could not be substantiated by further investigations.

Mikulicz's disease and syndrome are uncommon, there being but 81 cases reported in

the literature. The treatment in the latter condition is the treatment of the primary disease. There is apparently no specific treatment for Mikulicz's disease proper. Roentgen and radium therapy have given good results in some cases. Surgical removal of the affected glands has been resorted to in relieving disfigurement and the interference with vision. Sometimes the swellings have disappeared during the occurrence of some general infection, to reappear later. Spontaneous cure has apparently been known to occur.—*Karl Kornblum.*

GENERAL

Evans, Newton, and Ball, Howard A. Coccidioidal granuloma. *J. Am. M. Ass.*, Dec. 14, 1929, *93*, 1881–1885.

Fifty cases of coccidioidal granuloma which have occurred since 1916 at the Los Angeles County General Hospital were studied, and detailed statistics—clinical, pathological, bacteriological and roentgenological—are given.

Most cases occur between the ages of twenty and forty. Males predominate 41 to 9. Most patients have direct or indirect contact with the soil or with animals. Thirty-four per cent of cases give a history of respiratory infection preceding the initial external lesion. Duration of disease is from one to 62 1/2 months, averaging 9 1/4 months. Mild leucocytosis with a relatively low polymorphonuclear count is not uncommon. Most cases can be diagnosed during life by wet 10 per cent sodium hydroxide mounts and confirmed by cultures on Sabouraud's medium.

Roentgenographically the pulmonary lesion is a diffuse shadow simulating pneumonia. Often it is in the lower lobes. Late in the disease miliary distribution is common. Bone lesions are common, and peculiar sites of bone destruction in cases from regions where coccidioides infection exists should arouse suspicion.

Three main clinical types of the disease are recognized: (1) pathology largely pulmonary. Death results from this phase; (2) pathology uniformly distributed throughout the body; Death results from miliary distribution which eventually occurs; (3) pathology slight in extent, both pulmonary and somatic. These may result in chronicity until bodily resistance at some time is lowered and the organism develops sufficient activity to cause a miliary pulmonary involvement.—*G. R. Miller.*

ROENTGEN AND RADIUM THERAPY

Kuhlmann, B. Zur Prognose der Lymphogranulomatose. (The prognosis of lymphogranulomatosis.) *Strahlentherapie*, 1930, *35*, 296–298.

A case of lymphogranulomatosis occurring in a man twenty-two years of age who was treated by roentgen irradiation six and a half years ago is described in detail. At the time of the treatment the lesion extended chiefly to both parotid glands and the submaxillary and cervical lymph nodes. The diagnosis was confirmed microscopically.

The treatment consisted in the administration of 1/3 S.U.D. (0.5 mm. Cu and 1 mm. Al, 190 kv., 2 ma.) at intervals of six weeks for several series. The patient regained his normal health within a few months following the completion of the treatment and has remained well since.

The case is described since radiation therapy results only rarely in permanent healing of lymphogranulomatosis.—*T. Leucutia.*

Asti, Luigi Mario. Note di tecnica per la costruzione di apparecchi in pasta Columbia nella Radiumterapia di superficie. (Technique of construction of apparatus of Columbia paste for superficial radium therapy.) *Radiol. med.*, Dec., 1929, *16*, 1211–1273.

Columbia paste, which is made up of paraffin, wax and finely triturated saw-dust is superior in several respects to the substances which have been used before for applying radium to the surface of the body. When heated it is malleable and can be applied exactly to any surface to be covered; as it cools it hardens but is still malleable enough to adapt itself to the region of the body to which it has been applied. A particularly good property of this paste is that it is a good filter for secondary radium rays and does not emit any secondary rays of its own that could do any harm. It is also an excellent medium for diffusing the primary rays that traverse it, so that it is easy to obtain a homogeneous irradiation on the inner surface. Direct measurement is necessary to determine the amount of irradiation that has been admin-

istered and for this purpose the author uses the ionomicrometer of Danne and Mallet.

He reports a series of experiments that he made to determine the best localization for the radium and the relations existing between the irradiating surface and the zones of maximum intensity.

He tries to determine the boundaries of these zones for different depths. The different forms of apparatus are divided into ones with plane surfaces, ones with curved surfaces and ones with mixed surfaces and the percentage depth doses for the different forms worked out. He gives illustrations of a series of such apparatus that he has used in the treatment of cancer and points out the most remarkable characteristics of each one.—*A. G. Morgan.*

HOPWOOD, F. L. The Radium Department of St. Bartholomew's Hospital, London. *Acta radiol.*, 1929, *10*, 313–319.

The professor of physics gives an account of the organization and equipment of the radium department of the hospital. The total amount of radium element at the disposal of the Cancer Research Committee is at present 1100 mg., but will shortly be increased to 1600 mg. Of this 500 mg. are in solution and the remainder is distributed in several hundred platinum containers. The housing and equipment are described together with the radium emanation plant designed by Dr. René Ferroux. Various details of the equipment are illustrated. The general organization has already been described in the *British Journal of Radiology*, April, 1927, where full details of the rules enforced, the forms employed, etc., are given. The Radium Department on proper notice delivers radium to all hospital departments, collects it when unused or after use, keeps all containers in repair, keeps them in a safe custody when not in use and carries out routine tests and measurements. A daily census is kept of the number and location of all radium-salt containers, and complete records made of the number of hours of use, damages incurred and repairs effected. Similar records are kept of the production and employments of radon. —*A. G. Morgan.*

WALTER, E. Traitement radiothérapique d'un cas de calcification partielle dé la capsule articulaire de l'épaule. (Radiotherapeutic treatment in a case of partial calcification of the articular capsule of the shoulder.) *J. de radiol. et d'electrol.*, Nov., 1929, *13*, 617–618.

A case of calcification of the joint capsule of the right shoulder is briefly described in a man forty years of age who for a period of two months had suffered from intensive pain. The administration of salicylates failed to influence the symptomatology. From April 24 to May 13, 1929, six irradiations were given to the region of the right shoulder with the following technique: 12 min., 29 cm. spark gap, 3 ma., 8 mm. Al, 25 cm. skin target distance, field 10 cm. in diameter, total dose 3000 R, a slight erythema having appeared following the fifth and a pronounced erythema following the last treatment.

All the symptoms rapidly disappeared following the roentgen irradiation and a second roentgenogram taken one month later showed that the calcification had entirely absorbed.

The case is interesting since it proves that recent calcifications can be made to disappear by means of roentgen irradiation. Nothing is known with regard to the etiology of the calcification in this case.—*T. Leucutia.*

ROTH, M., and STEINER, E. Radioterapie afectiunilor inflamatorii acute. (Radiotherapy of acute inflammatory infections.) *Clujul med.*, Dec., 1929, *10*, 597–599.

The authors have used mild doses (1/10 to 1/2 S.U.D.) of superficial roentgen rays for the treatment of acute and subacute infections for a period of over three years. Satisfactory results were obtained in 74 per cent of the cases treated.

The opinion is expressed that the results are the better the sooner the treatment is instituted. In many cases the temperature dropped within ten to twelve hours following the irradiation and in others terminated by lysis within two to four days. During the same time there was a rapid amelioration in the general condition of the patient.

The roentgen treatment has proved of considerable value in the following conditions: phlegmon, carbuncle, furuncle, hydrosadenitis, paronychia, pyodermia, mastitis, etc. Twelve rather unusual cases are described briefly. —*T. Leucutia.*

Bruner, Edward. A propos du traitement des maladies de la peau par les rayons "limites" de Bucky. (Concerning the treatment of skin diseases with Bucky borderline rays.) *J. de radiol. et d'électrol.*, Nov., 1929, *13*, 612–615.

Two hundred cases of various skin conditions were treated by the author and the conclusion is reached that the application of the borderline rays adds nothing to the usual methods of roentgen irradiation. The sole indication for the borderline rays is in connection with superficial lesions of the scrotum and eyelids. Furthermore borderline rays in large doses may produce severe ulcerations. Two such instances were observed by the author and photographs of these ulcerations are reproduced.

Comparative experimental investigations of the action of roentgen rays, borderline rays and ultraviolet rays on orthonitrobenzaldehyde solution and on leucocytosis revealed that there is no difference between the biologic action of the borderline and of the roentgen rays.—*T. Leucutia.*

Brauer, A. Ueber Rationalisierung im Röntgenbetrieb des Dermatologen. (On standardization of roentgen procedures in dermatology.) *Strahlentherapie*, 1930, *35*, 259–264.

Since 1921 the author has used the hot cathode Coolidge tube for the roentgen treatment of various skin conditions. This necessitated the adaptation of the old Meyer table (which the author formerly used for gas tubes) to the new conditions. The figures illustrating the relation of the dose (expressed in X) to the various skin target distances are included.

The author found that by using a great focus skin target distance (of 44 cm.) a 30 per cent Sabouraud dose can be administered with 2.5 ma. current in the rather short time of 2 minutes. This results in great economy of time, and it enables the roentgen therapist to cover, especially in the generalized skin lesions, larger areas at one time.

The author describes in detail, with illustrations, a new tube stand which is built into the wall and which permits a very great flexibility for all angles and directions.—*T. Leucutia.*

Hoffman, J. M. Radium in the treatment of diseases with subcutaneous or mucous membrane hemorrhages. *Radiology*, Feb., 1930, *14*, 136–138.

Five cases are reported, comprising two of umbilical hemorrhage, two of purpura hemorrhagica and one of hemorrhage after circumcision, in all of which radium treatment of the spleen was given. Save in one of the cases of umbilical hemorrhage, bleeding was stopeed, and in both cases of purpura hemorrhagica the disease has not recurred. The author concludes that radium offers a new and valuable aid in the treatment of hemorrhagic diseases of the newborn, as well as in simple purpura hemorrhagica. In hemophilia radium will help in controlling the severe hemorrhages without other medication. He warns that if the total erythrocyte count is below 1,000,000 this method must be used very cautiously because of the hemolytic action of gamma rays, and preliminary transfusions should be given to bring the blood count above that level. —*J. D. Camp.*

Remer, John, and Belden, Webster W. X-ray diagnosis and therapy of thyroid disease. *Radiology*, Feb. 1930, *14*, 145–150.

The roentgen ray, properly applied, is a safe therapeutic agent, according to these authors. Certain cases of toxic goiter should be given the benefit of irradiation for at least four treatments, continuing it if improvement is noted, and referring the case to surgery if no improvement occurs. Irradiation does not increase the difficulty of subsequent operation. Irradiation before operation renders a patient a better surgical risk. The danger of hypothyroidism is negligible. The basal metabolism test is an important adjunct and the treatment should be governed by it. Severe cases should be hospitalized and a period of rest obtained before treatment is begun and after the first one or two exposures.—*J. D. Camp.*

Holzknecht, G. The roentgen treatment of morbus basedowii. *Radiology*, Feb., 1930, *14*, 139–144.

The author points out that since 1904 it has been known that morbus basedowii can be cured by roentgen treatment, about 60 per cent of cases showing cure and about 20 per cent improvement to a greater or less degree. He concedes that a very acute case of the disease

should be operated on because of the quick relief which ensues. Cases not responding to roentgen therapy and those with signs of tracheal compression by a large nodular struma should also be operated on. But there is no reason at all for giving up local treatment of the thyroid and there is no basis whatsoever for resorting to general skin treatment with borderline rays, as advocated in certain quarters. As to the rays producing adhesions which render subsequent operation difficult, statistics prove that adhesions, if found, were already there before treatment, and that they occur just as often in untreated as in treated cases.—*J. D. Camp.*

SOILAND, ALBERT. The present status of roentgen ray therapy in breast malignancy. *Radiology*, Nov. 1929, *13*, 388–391.

The author states that postoperative roentgen irradiation has been of tremendous value in diminishing pain, in destroying certain metastatic invasion, and in prolonging life; but the actual clinical cures, in the face of extensive metastasis, are few in number. He believes that preoperative irradiation has distinct value, especially if employed along the present lines of knowledge of radiation technique. It is reasonable to expect that roentgen rays in proper dosage can be valuable in inhibiting or destroying a pre-existing and as yet unoperated upon involvement. They should more readily destroy or inhibit the very early invading malignant cells, some of which are no doubt not even suspected or their presence accounted for by any demonstrable method of examination, so that they naturally escape surgical removal. He is convinced that in the cases in which adequate preoperative treatment can be carried out to a satisfactory conclusion recurrences are the exception and not the rule.

In his own clinic routine postoperative radiation treatment has been carried on for twenty years, and a certain amount of benefit has followed this procedure. No instances have been observed in which such treatment has augmented the disease or hastened its progress. In some advanced clinics the radio knife or electric scalpel is taking the place of the cold knife in resections of breast tumors, and it seems that this type of surgery has advantages over the ordinary scalpel in that a certain amount of sterilization follows the path of the instrument, and there is less hemorrhage and consequently less danger of knife implantation of degenerated cells.

It is the author's plan to employ preoperative irradiation on a larger scale, keeping as careful records as possible, so that the method may be more definitely evaluated.—*J. D. Camp.*

EVANS, WILLIAM A., and LEUCUTIA, T. The roentgen-ray treatment of intrathoracic tumors. *Am. Rev. Tuberc.*, Jan., 1930, *21*, 70–76.

In irradiation a tumor for therapeutic purposes, two factors have to be taken into consideration: (1) the primary response of the tumor to radiation, and (2) the reaction of the neighboring tissues influencing the irradiated tumor. While the first factor is concerned chiefly with the radiosensitivity of the individual tumor, the second depends on the particular structure of the normal tissues surrounding the tumor. In the roentgen therapy of intrathoracic tumors, both factors are of paramount importance.

The knowledge of the response of the tumor and its surrounding structures to radiation is important also, because it often serves as a basis of differentiation in cases in which a diagnosis by other means is impossible.

In order of their radiosensitivity, one may place, for practical purposes, the intrathoracic tumors in the following four main groups:

(1) Lymphoblastomata (lymphosarcoma, thymoma, pseudoleucemia, chronic lymphatic leucemia, etc.)

(2) Cellular anaplastic tumors (spindle-cell sarcoma and its varieties, teratoma, hypernephroma, Ewing's tumor, mediastinal Hodgkin's disease, etc.).

(3) Carcinoma, primary (chiefly of bronchogenic origin and, in rarer cases, of pleural, thymic and thyroid origin) and secondary.

(4) Benign tumors, dermoid cysts, pseudotumors (aneurysm, encysted pleural effusion simulating tumor).

In lymphoblastomata the largest bulky tumor masses entirely disappear within eight or ten days following irradiation. This rapid disappearance which is often called "melting away" is so typical that one can safely say that an intrathoracic tumor which has not entirely disappeared within ten days following irradia-

tion is not a lymphocytic cell proliferative process.

In cellular anaplastic tumors there is, as a rule, reduction to half of the original size within three to six weeks, and an entire disappearance within two to three months following irradiation

In carcinoma, in the early cases, the repeated application of deep roentgen therapy and the local use of radium occasionally leads to healing; in the advanced, bulky tumors, however, a temporary reduction in size is all that can be expected. The aim should be rather to produce a fibrosis of the part of the lung involved than to act on the carcinoma tissue itself.

In benign tumors, dermoid cysts, and pseudo-tumors the response to irradiation is nil.

Since the variation in the rate of response of the above four groups is within rather broad limits, it is advisable that check-up films be taken within ten days, six weeks, and, after this, every two months following the irradiation and that these be compared with the original films taken prior to treatment. Such a procedure, in addition to the information it gives with regard to the results of treatment, also serves as confirmation or disproof of the diagnosis previously established.

Method of Treatment. (1) If the tumor is confined to the mediastinum, a dose of from 110 to 130 per cent S.U.D. is administered. The cross-firing is done through anterior and posterior oblique portals of entry, with the patient lying semilaterally, at an angulation of 45°. Whenever possible, the periphery of the lungs is excluded from the radiation, that is, no direct lateral ports of entry are used.

(2) If the tumor is localized in both lungs, as in the majority of metastatic tumors by the hematogenous way, a dose of from 110 to 130 per cent S.U.D. is administered over both lungs.

(3) If the tumor is localized in only one lung or parts of the lung, as in the majority of primary neoplasms of the lung, and in some secondary tumors (especially carcinomata) a dose of 130 per cent S.U.D. is given over the site of the lesion. Since in these cases the production of fibrosis is to be desired, treatment can be safely repeated with rather large doses.

The factors used are as follows: 200,000 volts (peak), 1 mm. copper, 1 mm. aluminum as filters (efficient wave length 0.14Å), 70 to 80 cm. skin-target distance, large portals of entry, water-cooled tube, 100 per cent S.U.D. (on the surface of the skin) equalling 650 r.

The application of intravenous injections of colloidal lead in malignant tumors is comparatively recent. It is too early, therefore, to draw definite conclusions, but it appears that a combination of colloidal lead and roentgen-ray therapy is of noteworthy consideration.—*Authors' abstract.*

Langeron, L., and Desplats, R. La radiothérapie de la région surrénale; médication vaso-motrice. (Radiotherapy of the region of the suprarenals; vasomotoric medication.) *Presse méd.*, Jan. 11, 1930, *38*, 49–50.

The authors previously published their results obtained by the irradiation of the region of the suprarenals in certain forms of arterial hypertension, trophic and painful phenomena due to arteritis obliterans and certain paroxysmal vasomotor disturbances without arterial obliteration. In the present article they analyze the effect of the irradiation from the standpoint of vasomotor function.

1. Vasomotor results of roentgen therapy of the region of the suprarenals. These are purely clinical and to a large extent subjective. They consist (*a*) in a sensation of heat which appears very shortly after the roentgen therapy, no doubt due to increased capillary circulation; (*b*) in the cessation of pain which occurs soon after the treatment and which is often of a permanent nature (longest observation one year); (*c*) in the not infrequent amelioration of the intermittent claudication; (*d*) in the disappearance of erythromelalgic phenomena, and (*f*) in occasional improvement of trophic disturbances.

2. The action of roentgen therapy of the region of the suprarenals. Since the authors were unable to detect histological changes in the suprarenal glands removed following the irradiation, the effect of the roentgen rays must be through the sympathetic system. In this respect the suprarenals must form a connecting link with the sympathetic system as a whole.

3. Interpretation of results and mechanism of the action of roentgen therapy of the region of the suprarenals. The action of the roentgen rays on the sympathetic system consists chiefly in the reestablishment of the normal function

of the disturbed vasomotor reflexes. In this respect roentgen therapy differs considerably from sympathetic surgery which, as a result of the removal of sympathetic nerve fibers, leads to a permanent vasodilatation, while roentgen therapy reestablishes the equilibrium of the vasomotors without interrupting any of the sympathetic paths.—*T. Leucutia.*

GAUDUCHEAU, R. Curiethérapie des cancers inopérable du rectum par la méthode de Neumann et Coryn. (Curie therapy in inoperable cancers of the rectum with the method of Neumann and Coryn.) *J. de radiol. et d'électrol.*, Nov., 1929, *13*, 609–611.

Thirteen cases (9 men and 4 women) of inoperable carcinoma of the rectum have been treated since 1926 by the author according to the method of Neumann and Coryn which consists of the following three stages: (1) permanent colostomy; (2) curie puncture of the tumor by the anal coccygeal route, and (3) en bloc removal of the neoplasm and sclerosed rectum. An interval of eight days is allowed between the first and second stage and of six weeks to three months between the second and third stage.

In the author's cases only the first and second stages were performed. The immediate results were satisfactory, but it is too soon to express an opinion with regard to the final outcome.

The inconveniences of the method are: (1) possible hemorrhages shortly following the removal of the radium needles; (2) very slow healing of the anal coccygeal wound, sometimes lasting for a period of nearly a year, and (3) the appearance of very severe pain within one year following the radium needling (and lasting for a period of many months) due to the sclerosis brought about by the application of the radium. For this reason the removal of the tumor remnants and of the sclerosed rectum as practised by Neumann and Coryn appears indicated.

The method is of value only in the carcinoma involving the ampulla recti.—*T. Leucutia.*

DEL BUONO, P. Contributo radiologico alla patogenesi e terapia delle metrorragie essenziali giovanili. (Pathogenesis and roentgen treatment of essential metrorrhagia in young subjects.) *Radiol. med.*, Dec., 1929, *16*, 1191–1210.

Though the exact mechanism of the action of roentgen rays on the vegetative nerves has not been demonstrated, clinical experience and a great deal of experimental work have shown that small doses of rays do act on the nuclei from which the vegetative nerves originate, as shown by irradiation of the parahypophyseal region, on the cervical chain of the sympathetic, on the last dorsal vertebrae and the whole region of the pelvis and the genital system. Such irradiations may change the functional rhythm of certain organs or systems, as for example the sex glands, the skin, etc., if they have been changed as a result of primary disturbance of function of the glands of internal secretion or the conducting nerves of the vegetative system.

In the special case of excess of utero-ovarian function, that is, essential juvenile metrorrhagias, irradiation of the spleen, thyroid gland, the hypophyso-mesencephalic region and the uterus and ovaries sometimes gives satisfactory and permanent results if there is no primary organic disease of the uterus or ovaries. It is probable that any form of irradiation acts through the nerves of the vegetative system which controls the tonus of uterine and ovarian function. Irradiation of the nuclei or of the branches of the vegetative nervous system may modify the tonus of nerve conduction and establish equilibrium in the sympathetic-parasympathetic system or, as seems more probable, regulate endocrine-sympathetic correlation, as there are reasons for supposing that these functional disturbances are endocrine-sympathetic diseases.—*A. G. Morgan.*

MISCELLANEOUS

LACASSAGNE, A. The importance of filtration and superiority of pure gamma radiation in the radiotherapy of malignant tumors. *Radiology*, August, 1929, *13*, 95–102.

The work of Dominici established, since 1907, for units of radium salts, the greatest efficacy against cancer cells, and the greatest harmlessness for normal tissues of the gamma radiation obtained with a minimum filtration of 0.5 mm. platinum. It has been established experimentally that unfiltered units of radon provoke around themselves a zone of diffuse necrosis of all the tissues; this zone becomes narrower the more one increases the filtration or decreases the intensity of the radiation;

beyond a certain thickness of platinum and for a definite intensity, radium necrosis may be completely eliminated. Radium necrosis is the cause of grave accidents, such as hemorrhage, paralysis, neuritis, bony sequestration, radium dermatitis, perforation and infection. It offers no compensating advantage. The author believes that the techniques of curie therapy with pure gamma radiation, which offer the same technical possibilities, and a greater efficacy in the treatment of cancer than techniques with composite radiation, should be preferred to them.—*J. D. Camp.*

Cohn, Max. Die körperliche Darstellung der Haut im Röntgenbild. (The stereoscopic visualization of the skin in roentgenograms.) *Chirurg*, 1929, *1*, 784–787.

The author devised a plan for the roentgen stereoscopic visualization of the skin surface of different body parts so as to be able to more accurately estimate the depth from the surface of the skin of lesions or foreign bodies examined. This consists in the placement of landmarks on the two opposite surfaces (as, for example, a penny on the anterior and the letter R or L on the posterior surface) and the spiral winding of a special bronze coated adhesive around the part of the body to be examined.

Four pairs of stereoroentgenograms are presented in order to show the practical value of the method.—*T. Leucutia.*

Stephani, Jacques. De l'emploi de l'antidiffuseur pour les radiographies pulmonaires. (The use of the Bucky diaphragm in pulmonary roentgenograms.) *J. de radiol. et d'électrol.*, July, 1929, *13*, 393–396.

By making use of the rotating Bucky diaphragm (of Åkerlund) the author was able to obtain good roentgenograms of the chest. It was found that if the distance was 1 meter 50 cm., the time of exposure had to be increased 2½ to 3 times above that without the use of the Bucky diaphragm. The images were superior to those obtained by any other method and they were of great diagnostic value, especially when the demonstration of structural details of the lungs was desired. In large pleural effusions there was no advantage in the use of the method.

If the regular Potter-Bucky diaphragm is used, an arrangement must be made to run the grids of the diaphragm perpendicularly.—*T. Leucutia.*

Brams, Julius, and Darnbacher, Leo. The effect of x-rays on the gall-bladder: experimental production of an x-ray cholecystitis. *Radiology*, August, 1929, *13*, 103–108.

A definite acute and chronic cholecystitis was experimentally produced in a series of dogs with doses of roentgen rays that are within the range of those used for therapeutic purposes. The extent of the inflammatory process is dependent upon the dose and reaches a maximum after a period of twelve days. The changes vary from small, isolated petechial hemorrhages to a diffuse edema and an advanced, infiltrated fibrous cholecystitis. The changes are most marked in, and in a majority of cases are limited to, the fundus of the gall-bladder. Basing their opinion on the relative lack of injury to the exposed portion of the duodenal and pyloric mucosa, the authors believe that the gall-bladder epithelium is comparatively more sensitive to roentgen exposure than the other organs in apposition to it. The possibility of injury to the gall-bladder following deep therapy in the region of the right upper quadrant of the abdomen must be borne in mind.—*J. D. Camp.*

Casati, A. Sulla presenza di "zone di azione" nei corpi irradiati come effetto dell'irradiazione con raggi X. ("Zones of action" in irradiated bodies.) *Radiol. med.*, Nov., 1929, *16*, 1138–1144.

The author made a study of the action of roentgen rays on bone marrow and on solutions of 1 per cent sublimate. He found that the action of the rays was not uniformly distributed but that they acted on certain circumscribed and discontinuous zones of the irradiated body. He concluded that this distribution of the effect is connected with certain secondary phenomena of irradiation. The changes brought about are a resultant of various energies acting at the same point at the same time and reinforcing or annulling each other. Visible effects are produced only under certain conditions. Outside these conditions and with an amount of energy less than the threshold necessary, no visible effect is produced.—*A. G. Morgan.*

CANTI, R. G. Biological effects of radium irradiation. *Acta radiol.*, 1929, *10*, 320–331.

The earlier observations on the histology of tumors irradiated with gamma radium rays are described. The difficulty in interpreting the results led Strangeways and his coworkers to study the effect of radiation on tissue cultures. The most important changes produced are: a cessation of mitosis, which is immediate; the return of mitosis in large numbers and abnormal forms in three to four days; disappearance of mitosis for the second time in eight or nine days; presence of cell débris which is removed by phagocytes; the replacement of the new growth by fibrous tissue; mummification which is rare and found in certain cases where the destroyed new-growth is not absorbed. It was comparatively easy to observe these changes but the mechanism by which they were brought about was not so evident.

The hypothesis of delayed lethal dose is considered. An experiment is described which gives a naked-eye demonstration of the effect of beta rays on a row of cress seeds. The time-intensity ratio is then considered and the results of experiments on tissue cultures show that there is a threshold of intensity and a threshold of time, each of which must be passed before radiation has any biological effect. A comparison of the time factors used in these experiments and by radiologists leads to the subject of indirect action, which is briefly discussed. The selectivity of action of gamma rays on cancer cells is illustrated by cuttings from cinematograph films of tissue cultures of normal cells and malignant cells from Jensen's rat sarcoma and a photograph is given demonstrating the selective action of beta rays on colon bacilli in an agar culture of streptococci and colon bacilli. Reference is made to stimulation an an experiment described on tissue cultures showing an increase in cell division which might erroneously be considered the result of stimulation.—*A. G. Morgan.*

BODE, H.-G., and RIECKE, E. Zur Histologie sensibilisierter roentgenbestrahlter Haut. (On the histology of sensitized roentgen irradiated skin.) *Strahlentherapie*, 1930, *35*, 265–289.

The author sensitized the skin of guinea pigs and white rabbits with chrysarobin, iodine and croton oil (and in a few instances with injections of salvarsan) and then exposed it to roentgen irradiation.

The hair of the animals was removed (in guinea pigs on the back and rabbits on the thighs) and two days later the bare areas were treated (twice daily, for three days) with the above substance. The roentgen irradiation was carried out with unfiltered roentgen rays (0.6 mm. half-value layer aluminum) in doses of 957 r, some of the animals being irradiated the third and others the fifth day following the sensitization.

Salvarsan sensitization was applied only to rabbits by injecting 0.275 gm. myosalvarsan per kilogram body weight intramuscularly at 10 A.M., and by irradiating the animal the same day at 6 P.M.

The irraditions were carried out in such a manner that half of the sensitized areas and an equal part of a normal (unsensitized) skin was included within the field of irradiation (so as to have control sections for the changes produced by either the irradiation or sensitization alone).

In none of the animals was there any evidence of macroscopic changes. Within eight days part of the skin from (*a*) only sensitized; (*b*) only irradiated, and (*c*) sensitized and irradiated areas was removed and examined microscopically.

It was found that roentgen irradiation of the sensitized skin resulted in increased structural changes as compared to the modifications brought about by either the sensitization or the irradiation alone. The structural changes were present both in the epidermis and subepithelial connective tissue. In the epidermis they consisted of liquefaction, edema, pycnosis, hyaline degeneration, etc., while in the subepithelial connective tissue they were characterized by destruction phenomena of a moderate degree. The changes were especially pronounced in the skin sensitized by salvarsan where there was also evidence of mild inflammation.—*T. Leucutia.*

HENRARD, E. Commotion électrique à 110 kilovolts, accident de laboratoire. (Electrical shock at 110 kv., laboratory accident.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, *17*, 262–263.

The author describes a very unusual accident which occurred during the taking of a roentgenogram. For some reason the high tension

starter failed to function and the operator disconnected the tube to test the machine. After starting and stopping the machine several times the impression was gained that the high tension starter began to work and the operator proceeded to reconnect the tube. While touching the wire he got a heavy shock.

What most probably happened is that the starter (through fusion) established a permanent contact, thus sending the high tension current through the line, when the operator thought that no current was on.

It is recommended in connection with this: (1) that one should never try to connect or disconnect high tension tubes or the milliammeter while the machine is running; (2) that a red signal light be placed in the primary circuit of the transformer indicating when the high tension current is on, and (3) that an automatic device be provided with each apparatus, stopping the machine whenever there is an accidental contact with the high tension circuit.—*T. Leucutia.*

Pfalz, G. J. Die immunbiologische Bedeutung von Röntgenschwachbestrahlungen für die bactericide Kraft des Blutes. (The immunobiologic effect of mild roentgen irradiations on the bactericidal power of the blood.) *Arch. f. Gynäk.*, 1929, *138*, 93–110.

As a result of previous experiments the author found that the nonspecific, specific and combined protein injections (novo-protein, yatren-casein, gono-yatren, autogenous gonococcus, streptococcus and staphylococcus vaccines) led to an increase in the bactericidal power of the blood, characterized by the following four phases: (1) an initial decrease (Weichardt) lasting for a period of a few hours (negative phase); (2) an acute increase occurring regularly within four to six hours following the injection; (3) a phase of exhaustion lasting from eight to twenty-four hours following the injection, and (4) a continuous gradual increase lasting for a period of several days.

In the present article the results of the experiments with mild doses of roentgen rays (as employed for the treatment of infections) are given. The microorganism used for the determination of the bactericidal power of the blood was the yellow hemolytic streptococcus and the method that of Wright.

The irradiation included 20 cases of acute infections (180 kv., 4 ma., 40 cm. skin target distance, 10 by 15 cm. field, 0.8 mm. Cu, one abdominal and one dorsal field, 10 per cent s.u.d. at the site of infection), and 30 cases of preclimacteric metro- and menorrhagias (in which either a temporary castration dose of 25 to 28 per cent s.u.d., or a permanent castration dose of 36 to 38 per cent s.u.d. was administered by using identical factors).

It was found that in both instances in 71 per cent of the cases there was an increase of the bactericidal power of the blood as a result of the irradiation. The immuno-biologic phenomena were characterized by the same four phases as described for autogenous vaccines or protein reactions. From this the author concludes that since the end-effects of the protein injections and of the mild irradiations are the same the mechanism leading to them and the cause provoking them must also be the same. In other words, the effect of mild doses of roentgen rays must be through the activation of the protoplasm (Weichardt) which is the seat of all proteolytic and immuno-biologic processes.—*T. Leucutia.*

Glocker, R., and Reuss, A. Strahlenschutzmessungen. (Measurements in radiation protection.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, September, 1929, *40*, 501–507.

1. Determination of the lead absorption coefficient. The recommendations of the Protection Committee of the Second International Congress give the following thicknesses of lead as essential for complete protection (between the voltages of 100 kv. and 200 kv).

100 kv.	1.5 mm. lead
125	2.00
150	2.5
175	3.0
200	4.0

By investigating the absorption coefficient for the above values, the authors found that the lead absorption remains practically constant between 100 and 200 kv., and that consequently a specification of the lead thickness for 125, 150 and 175 kv. is unnecessary, or at least does not have a physical foundation.

2. The protection of a Metalix therapy tube was tested photographically and ionometrically. It was found that by running the tube at 200 kv. and 5 ma. one may approach the tube from all angles within a distance of 0.5 meter

without exceeding the dose considered as safe by Mutscheller.

3. The lateral scattered radiation emanating from the subject submitted to a roentgenologic examination is considerably greater than hitherto supposed. In experimenting with a water phantom of 20 by 20 by 20 cm. it was found that a voltage of 110 kv. leads at a distance of 50 cm. from the center of the phantom to a scattered radiation which is as large as that produced by a highly filtered therapy tube running at 220 kv. This exceeds the safe dose of Mutscheller by eight to twenty times, indicating the necessity for greater precautions in diagnostic roentgenoscopy.—*T. Leucutia.*

Gunsett, A. L'évaluation en unités r électrostatiques et en unités R Solomon des réaction cutanées, avec qualques remarques sur la dépendance de la longueur d'onde du nombre d'r correspondant a une même réaction cutanée. (The evaluation of the cutaneous reactions in r (electrostatic) units and in R (Solomon) units, with some remarks on the dependence on the wave length of the number of r leading to the same cutaneous reaction.) *J. de radiol. et d'électrol.*, June, 1929, *13*, 332–336.

The author emphasizes the inadvisability of too sudden a change from the R (Solomon) to the international r as adopted in Stockholm.

A dose of 550 r (field 48 sq. cm., 0.5 mm. Cu) produces, according to German investigators, an erythema of the skin appearing eight days following the irradiation and lasting for a period of three weeks, while 605 r leads to first degree, 660 r to second degree, and 715 r to third degree radiodermatitis. In transposing a dose of 3000 R which is used routinely at the Strasbourg Clinic into absolute units, it was found that this would correspond to 827 r, a dose which according to the above figures should produce a third degree radiodermatitis. A dose of 4500 R with 2 mm. Cu given in fractions over a period of four to five days, on the other hand, would correspond to 842 r applied in one single sitting. It appears that further investigations are necessary in order to elucidate this great discrepancy in the doses applied before resorting to their change into absolute units.—*T. Leucutia.*

Gueben, Georges. A propos des techniques de mesures des radiations pénétrantes. (Concerning the technique of measurement of penetrating radiations.) *J. de radiol. et d'électrol.*, July, 1929, *13*, 389–392.

The procedures of measuring penetrating radiations may be classed into two groups: (1) the measurement of the rate of charge of a conductor under the influence of the ionization current, and (2) the measurement of the rate of discharge of a conductor preliminarily charged and submitted to the action of the ionizing agent. The procedures of the first group, among them the method of Piccard, lead to practically no errors since the insulated conductor is charged to a very low potential and consequently the loss of charge is extremely small. The procedures of the second group make use of the ionization chamber which may be of the large chamber and of the thimble chamber type. In the large chambers the errors, whether the measurement is done galvanometrically or electrometrically, are likewise small, but in the thimble chambers they are often very great.

In analyzing the cause of the errors in thimble chambers the author found that they are due in no small part to the change in conductivity of the insulating materials (usually amber, or more recently ceresin, as for example in the dosimeter of Glasser and Seitz) used for the connection of the small ionization chambers to the cable leading to the measuring instrument.

Already in 1896, Thomson and McClelland observed that the conductivity of solid and liquid dielectrics increased following irradiation. Numerous investigations carried out since that time only served to confirm these observations. The author recently submitted ceresin (a very hard paraffin extract from ozocerite) to the action of the gamma rays of 83 mg-el. of radium and found that the conductivity increased within two to three hours following the irradiation 100 times, and that this increased conductivity did not die off until twenty-four hours following the cessation of the irradiation.

This, then, indicates that whenever a small ionization chamber, or the dosimeter of Glasser, is submitted to irradiation, an ionization current develops not only within the ionization chamber, but in the solid dielectric as well, leading to an error the value of which cannot be underestimated. Generally, the larger the field of irradiation and the greater the intensity

and penetration of the rays, the greater the error committed.—*T. Leucutia.*

Strauss, Siegmund. Das Grenzstrahl-Mekapion und weitere Verbesserungen am Röntgen-Mekapion. (Borderline-ray mecapion and further improvements in the roentgen mecapion.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 655–659.

A new mecapion designed for the purpose of measuring the borderline rays of Bucky (in the neighborhood of 10 kv.) is described in detail. The ionization chamber is constructed, following recommendation, of goldbeater's skin and the clock arrangement is changed so that one signal interval corresponds to 15 r.

Changes were also made for the roentgen mecapion by constructing a new ionization chamber which is entirely independent of the hardness of the rays (between 120 and 200 kv.), and by providing the instrument with an automatic stop which is mounted on the roentgen ray machine.—*T. Leucutia.*

Küstner, Hans. Die Rolle der grossen und der kleinen Ionisationskammer bei der Röntgenstrahlenmessung. (The rôle of the large and small ionization chamber in roentgen measurements.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 603–628.

This article represents a summary of the basic principles of roentgen dosage measurements with both the large and small ionization chambers. The value of these chambers, their dependence on the hardness of the roentgen rays, the importance of saturation, the errors of measurements and their prevention in deep and superficial therapy, the standardization in absolute r, and the control with radium sources are discussed in detail. The conclusion is reached that large ionization chambers lead to more accurate results than small ionization chambers but that in practice where an absolute accuracy often is not required small ionization chambers are of greater advantage. They permit the actual measurement of the dose on the patient and they allow water phantom determinations which are impossible with the large ionization chambers.—*T. Leucutia.*

Chantraine, H., and Profitlich, P. Künstliche Radiumstrahlen? (Artificial radium rays?) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 659–664.

Every radium worker must gain the impression that the action of radium, especially on tumors, is superior to that of roentgen rays, due no doubt to the higher penetration of the radium rays.

This brings up the problem of the advisability of increasing the voltage in deep therapy apparatus. Several investigators found no difference in the action of the roentgen rays when increasing the voltage from 200 kv. to 240 kv., but in order to get rays as hard as those of the radium source one would have to increase the voltage to 1500 kv.

The authors experimentally irradiated a film placed perpendicularly in a water phantom by a radium source of 50 mg. element (23 cm. distance) and compared (with the aid of the densographic method) the effect on the photographic film at 10 cm. depth with that of deep roentgen rays. They found that in radium the amount of scattered radiation 3 cm. laterally from the beam of the rays was 24 per cent and 5 cm. laterally 18 per cent, while in the case of deep roentgen rays (200 kv., 0.5 mm. Zn, 6 by 8 cm. field, 23 cm. distance) the scattered radiation 3 cm. laterally from the radiation beam amounted to 30 per cent, and 5 cm. laterally to 22 per cent. This indicates that a great difference in the scattered radiation produced by the hardest roentgen rays and those used nowadays cannot be expected. Of course the discovery of some new effect (similar to the Compton effect) might entirely change the aspect of the problem, leading to practical results which cannot be computed on the basis of theoretical calculations.—*T. Leucutia.*

Dauvillier, A. Anwendung der Grundlagen des Fernsehens in der Röntgenologie: der "Radiophot." (The application of the principles of television in roentgenology; the "radiophot.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, *40*, 638–654.

As is known roentgenoscopic images lack brightness and they are greatly fogged by scattered radiation. They are neither apt for reduction in size nor for reproduction. Furthermore, the energy sources which are necessary for their production are harmful both to the patient and to the examining roentgenologist.

In order to overcome the above disadvantages, the author in 1915 for the first time tried to apply the principle of television for

roentgenoscopic examinations, by making use of the double disc of Nipkow. The apparatus so constructed was called the "radiophot." It consisted of a rotating disc which served for the analysis and synthesis of the image, the disc containing small holes spirally arranged at definite distances. The holes serving for the analysis of the image were covered with black paper and the ones serving for the synthesis with stoppers of lead glass. The disc also contained spirally arranged crystal lenses for the amplification of the light intensity of the image to 100.

The disc which is placed between the roentgen source and the object to be examined is rotated during the time of the examination so that parts of the object are thrown by the roentgen bundles coming through the analytic holes on a large ionization chamber (specially constructed so as to deliver a maximum ionization) serving the purpose of a detector. The ionization current which is amplified is connected to a light source illuminating the "synthetic" holes. In case of individual observation a neon lamp which is placed in the focus of the condensor is used, while in case of demonstration to a large audience, the image is projected with the aid of the Kerr system.

The different parts of the apparatus such as the ionization chamber (which must yield the greatest amount of ionization possible and which therefore is made of metal walls and filled with either argon or krypton gas), the amplifier, the light source and the Kerr system for projection, as well as the changes necessary in the construction of the roentgen source, are discussed in lengthy detail.

More recently new improvements have been added to the apparatus, making its use more practical. Thus the disc which divided the image at the beginning into 100 elements, was provided with a new arrangement of the holes permitting a division into 900, and more recently into 3600 elements. It is hoped that in this manner a satisfactory examination of a larger portion of the body can be obtained.

The advantages of the apparatus are that the images, because of their transmission into fractions of elements, are entirely free of the effects of scattered radiation and fogging, that they can be reduced to any size, that they can be projected to any place, and that they can be photographed cinematographically. At the same time there is a maximum protection to both the patient and the roentgenologist.—*T. Leucutia.*

BRAUN, R., AND KÜSTNER, H. Zur Physik der Fingerhutkammer. III. Die genauigkeit der Absolutbestimmung der Röntgeneinheit mit Fingerhutkammer und Fasskammer. (The physics of the small thimble ionization chamber. III. The accuracy of the absolute determination of the roentgen unit with the thimble chamber and large air chamber.) *Strahlentherapie*, 1929, *33*, 273–295.

In a very careful theoretical and experimental study of Fricke and Glasser's proposed use of a small air wall chamber in the determination of the absolute r-unit, the authors arrive at the conclusion that the error in measuring the "r" with this method is considerably larger (+ 6.3 per cent) than when using the large air chamber apparatus (± 1.5 per cent). In these experiments ten small ionization chambers of different construction were used with various qualities of radiation. The largest error is caused by the difficulty of accurately measuring the volume of the small chambers and also by the difficulty of correctly interpreting the dependence of the electron emission of the air wall upon the radiation quality. All small chambers must be calibrated by means of a large air chamber, and therefore the latter should be given the preference over the small chamber method in determining the r-unit. —*O. Glasser.*